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RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY

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RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY

(1961-1963)

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FOREWORD
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ПРЕДИСЛОВИЕ
PREFACIO

The present bibliography on Radioisotopes and Ionizing Radiations in Entomology*, covering 1961 to 1963 inclusive, is a direct continuation of the first volume** which covered the period of 1950 to 1960. It is significant of the tremendous increase in research that the amount of work published during the three-year interval of 1961 to 1963 exceeds that of the preceding eleven years. An attempt has been made to maintain a fully annotated documentation for reference purposes in this broad field.

As before, a special effort has been made to present sufficient detail with each reference. Abstracts have therefore been included. A special feature of the detailed subject index available is the indication of the particular radioisotope or radiation used, given with individual reference citations. Some data on insect dispersal and sterilization, and on insecticides are shown in tabular form. It is hoped that the bibliography will prove of practical use to the specialist requiring a rapid survey of relevant publications in related disciplines, the person in search of detailed documentation on some particular aspect, and the scientist in a developing country whose access to the world literature might be somewhat limited.

The bibliography was compiled by Mrs. M. Binggeli of the Agency's Division of Scientific and Technical Information.

Readers are invited to adress their suggestions and other correspondence regarding the "Bibliographical Series" to: The Director, Division of Scientific and Technical Information, International Atomic Energy Agency, Kärntner Ring 11, Vienna I, Austria.

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* Bibliographical Series of the IAEA No. 15.

** Bibliographical Series of the IAEA No. 9.

La présente bibliographie consacrée aux radioisotopes et aux rayonnements ionisants en entomologie* couvre les années 1961, 1962 et 1963 et fait suite au premier volume** qui correspond à la période 1950-1960. Le fait que le volume consacré aux trois années 1961-1963 contienne plus de références que le précédent, qui couvrait un intervalle de 11 ans, souligne l'essor rapide de la recherche. On s'est efforcé de présenter, comme précédemment, une documentation complètement annotée sur ce vaste domaine à des fins de référence.

Comme dans le précédent volume, on s'est efforcé surtout de donner suffisamment de détails sur chaque ouvrage cité, notamment en donnant un bref résumé et l'index détaillé par sujets spécifie le radioisotope ou le rayonnement utilisé et donne des indications sur chaque cas. Certains renseignements sur la dispersion et la stérilisation des insectes sont donnés sous forme de tableaux. On espère que cette bibliographie intéressera les spécialistes qui désirent consulter rapidement la liste des publications dans

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INTRODUCTION

GUIDE ON COMPILATION

SOURCES

The bibliography was compiled from the open literature. A first routine search consisted of scanning selected secondary sources:

(a) Abstracting journals
  Biological Abstracts (BA)
  Bulletin Bibliographique (BB): Isotopes. Rayonnements. Agriculture. (Includes keywords but no abstracts)
  Chemical Abstracts (CA)
  Dissertation Abstracts (DA)
  Nuclear Science Abstracts (NSA)
  Nuclear Science Abstracts Japan (NSA/J)
(b) Title listings
  Agricultural Index (AI)
  Bibliography of Agriculture (BAg)
  Current Science

Subsequently, primary sources were scanned, abstracts being prepared where necessary, and references cited in original papers followed up: Numerous books, conference proceedings, bibliographies, reports, and selected journals were scanned, including review series such as: "Advances in Pest Control Research", Vol. 5 (Metcalf, R.L., Ed.), Interscience Publishers, New York (1962). "Annual Review of Entomology", Vol. 7 (1962), Vol. 8 (1963), (Steinhaus, E.A., Smith, R.F., Eds), Annual Reviews, Inc., Palo Alto, Calif. "Advances in Genetics", Vol. 10 (1961); Vol. 11 (1962), (Caspari, E.W., Thoday, J.M., Eds), Academic Press, New York.

The source of each abstract is indicated by means of the abbreviations above or by "(Auth.)" where the author's own abstract has been used; when no source is cited the abstract has been prepared by the compiler. Papers published as abstracts only were cited verbatim.

Reports

Some progress reports, preprints and abstracts of, so far, unpublished Conference Papers have been included; they are considered to be valuable as indications of future developments.

REFERENCES

References are arranged according to subject matter as laid out in the table of contents. Articles reviewing the particular subject or of a general or introductory nature are placed at the beginning of a section. Such reviews are more specific than those contained in BIBLIOGRAPHIES AND GENERAL SURVEYS, where broad fields are surveyed. Within a section, references are listed alphabetically by first author. References which were published prior to 1961 but had not been included in the preceding bibliography are marked by an asterisk.

Cross-References

These are cited at the end of each section, giving the (English) title, first author, the year of publication and the reference number. Despite the very complete subject index cross-referencing has been used extensively.

TECHNIQUES

Selected papers representative of particular techniques (e.g. autoradiography, dosimetry, neutron activation analysis, etc.) have been grouped together.

ADDENDUM

As in the first volume, documentation on radioisotope and radiation studies on nematodes of agricultural interest has been included.

INDEXES

(1) Author Index

Underlining is used to indicate the first author, in cases of joint authorship. As far as possible, up-to-date affiliations have been indicated for each author.

(2) Subject Index

A complete subject index is provided. The radioisotopes or radiations used are indicated with each reference. The following convention has been adopted concerning the position in which they are cited with regard to a particular study. When the radioisotopes or radiations represent the cause they precede the phenomenon, when used as a tool for analyzing existing conditions they follow the phenomenon under study. This is illustrated below.

Radioisotopes

Studies using the same radioisotope are listed under that isotope, with the exception of H^3, C^{14}, and P^{32}; since these isotopes have been applied particularly widely, they are more logically approached via the problem investigated.

Radioisotope	Radiation
P^{32}: genetic effects: 479 (genetic effects incurred through use of P^{32})	γ: ovary: 1185 (effects of γ-irradiation on ovary)
	x: malformations: 1266 (effects of x-irradiation in terms of malformations produced)
	β/MEA: radiosensitivity: 1160 (/= additional experimental factor, introduced before, during or after irradiation)
dispersal, P^{32}: 72 (dispersal traced by means of P^{32})	development, x: 1507 (development detected and studied by means of x-rays)

Radiations

Due to the large number of references involving the use of γ- and x-rays, these ionizing radiations have not been entered as separate headings in the subject index.

Insects

Scientific and common names have been given. In order to facilitate the use of the index for the non-specialist, insects have not been listed by order or family, but rather under common names. Thus, aphids, ants, cockroaches, grasshoppers, fruit flies, locusts, mosquitoes, and silkworms have been used as group headings rather than applying the scientific approach of, e.g., classing cockroaches, and grasshoppers and locusts together under Orthoptera, or under Blattidae and Acrididae, respectively.

Insecticides

Metabolic studies are not indicated specifically; where particular attention has been paid to residue analysis or insecticide synthesis this is mentioned with the citation. Special indexes (No. 3 and 4) have been compiled.

(3) Common and Manufacturers' Insecticide Name Index

(4) Letter-and-Number Insecticide Index

APPENDIX

Table I on the dispersal of radioisotope-marked insects indicates one area in which radioisotopes have been used widely and with considerable success. The complexity of factors which enter into range determinations do not allow easy tabulation of data, and the table represents an illustration rather than a comprehensive summary of results obtained by means of radioisotopes.

Table II summarizes data on the radiation-induced sterilization of 42 species of insects, and lists the insect, the stage irradiated, the dose and radiation used and, where applicable, additional variables which modified the effects of irradiation.

Table III lists radiotracer studies on insecticides; the chemical names and other designations are indicated for the various metabolic and other studies tabulated. The particular radioisotope used is listed, together with the animal or plant investigated, or the analysis or synthesis carried out.

ACKNOWLEDGEMENTS

The compiler of the bibliography is greatly indebted to Dr. J.C. Keller, of the Joint FAO/IAEA Division of Atomic Energy in Agriculture, who has been very helpful throughout its preparation; to Dr. J. Monro, of the Division of Research and Isotopes, for his comments and advice on various occasions, and to Dr. E.E. Kenaga, of the Dow Chemical Company, Midland, Michigan, USA, for permission to use the chemical names and other designations for certain compounds* as set out in his article "Commercial and Experimental Organic Insecticides", in Bull. ent. Soc. Amer. 9, 2 (1963) 67-103.

SURVEY

The following introduction is a commentary on the main lines of research in which radioisotopes and ionizing radiations have been used in the period under review. For detailed information reference is made to the relevant sections of the bibliography. The discussion on isotopes (p.4) is more extensive than on radiations (p.21) because of the great variety of problems investigated. The main applications of radiation have been summarized, particular emphasis being given to those fields in which the IAEA is actively engaged.

PROBLEMS IN THE USE OF RADIOISOTOPES

(1) Choice

The choice of an isotope in entomology is governed to a considerable extent by its toxicity to the insects, its effective half-life, and its suitability as an emitter. The energy and type of emission (β or γ) determines in turn the equipment required for its detection. For example P^{32} has most often been used for dispersal studies (Table I) because it is easily detected, fairly safe in use, and has an adequate half-life; its relatively weak β-emission is, however, useless for tracing insects underground, and for this purpose a powerful γ-emitter such as Co^{60} must be used. Problems involved in the choice of isotopes have been reviewed by various authors (4, 453, 451, 481). The extent to which tagging has become a routine operation may be gauged from the fact that the release of lots of 3×10^6 P^{32}-labelled mosquitoes has been reported (66).

In labelling insects several methods have been used, depending on the radioisotope, the species, the developmental stage to be labelled, and the conditions and period of observation envisaged. Commonly insects are reared in a labelled medium or with access to labelled water (457). Thus P^{32}-labelled honey was used for tagging ants (43), Au^{198}-labelled nutrients for bumble bees (44), and other labelled foods for various other species (65, 72, 84, 449, 450, 452). Alternative techniques include labelling via radioactive plant hosts (12, 15, 16, 21, 25) and animal hosts (139, 140-1, 448, 459, 462, 483, 485-7, 489-91), dipping (63, 83, 89, 98), painting (459, 463), spraying (71, 455), direct injection (175), exposure to radioactive gases, and the attachment of labelling strips (12, 13). In some cases two lots of the same insect have been labelled with different isotopes in order to identify different release sites (69).

Apart from the above examples, a number of additional labelling techniques and devices have been developed to suit particular needs (e.g. 64, 455, 463).

(2) Detrimental effects of radioisotopes

The possibility of detrimental effects from ingestion or topical application of radioisotopes must be considered. Such effects may take the form of delayed, abnormal or inhibited development, reduction in life-span or of the reproductive potential, or genetic effects.

The occurrence of developmental effects will, apart from other factors, depend on the radioisotope concentrations and insect stages used (21). P^{32}, applied in the larval medium of Culex pipiens molestus Forsk., affected growth and development (466), but efficient labelling of emerging adults was possible at ~0.1 μc/ml. Ephestia kühniella, reared on Sr^{89}-treated food invariably suffered a delay in development (471); similar effects and even abnormalities were found in Habrobracon (472).

A reduction in life-span was caused in Habrobracon juglandis by Pu^{239} (469, 470) and Sr^{89} (472), and in the parasite Meniscus agnatus by P^{32} (22). In the boll weevil, Anthonomus grandis Boheman, mortality from P^{32}-ingestion was higher at the larval than the adult stage (476). Co^{60} did not seriously affect Pissodes strobi when an activity of ~250 μc was used for short (1-2 months) periods; but for periods exceeding 9 months only ~50 μc Co^{60} could be used (463).

Effects on the reproductive potential can be considerable. Ingested Pu^{239} caused a marked drop in fertility and fecundity in Habrobracon juglandis (469, 470), and progressively fewer progeny were found in Ephestia kühniella from adults reared on Sr^{89}-treated food (471). Effects following the ingestion of Zn^{65} may in part be ascribed to its toxicity (168). The genetic effects of fourth period metals are considered in 169. Oviposition has, however, been found to be inhibited by even such a weak β-emitter as L-methionine-methyl-C^{14}. Its injection into the haemolymph of last instar nymphs of Gryllus assimilis (F.) induced radioactivity in the male and, subsequently, in the female (465). A similar effect was observed in the cotton leaf worm, Prodenia litura (F.), (467) after injection of labelled methionine into the haemolymph of newly emerged moths (467).

---

* See Table III

Genetic effects have been observed in a number of cases. A mutagenic effect due to tritium labelling was found in Drosophila melanogaster (473-4), and genetic effects were sometimes found when DNA-precursors labelled with H^3 (475) and C^{14} (477) were used. A direct comparison has been made of the effects of ingested P^{32} and x-irradiation in terms of induced chromosomal aberrations in Drosophila melanogaster (479) and the grasshopper, Gesonula punctifrons (970). In Drosophila the peak production of sex-linked recessive lethals proved to be the same for P^{32} and x-rays (479). Incidental genetic effects of ingested Sr^{89} have been observed in Habrobracon (472).

INSECT ECOLOGY

(1) Behaviour

Various aspects of insect behaviour have been profitably studied by means of radioisotopes. Feeding has been investigated from the points of view of the mechanism of feeding, feeding habits and, in the case of social insects, the transmission of food*.

Feeding activity

Some radioisotope studies have been made on the rhythm of feeding activity of a particular stage, which is influenced by such factors as the season, time of day (13), light (25), temperature, wind, etc. The daily activity and feeding behaviour of Eurygaster integriceps Put. was followed with Ta^{182}, and revealed a change in behaviour pattern prior to migration (12, 13); P^{32}-labelling was used in another study (53). Feeding rates in aphids (12) and individual feeding activity (23), which was then correlated with the course of the labelled food were investigated with P^{32}. When Aphis fabae Scop. are attended by ants (12), a significant increase in feeding and excretion rates occurs. Feeding rates were also studied in the beetle Chrysomela knabi (143); the rate of Cs^{137}-elimination allowed overwintering and newly emerged adults to be distinguished. The consumption of vegetation in a contaminated area (14) was estimated using Cs^{137} and Sr^{90}. A mathematical expression for the feeding and elimination rates of adults and larvae has been proposed (27). The feeding activity of fleas has been studied in the field (33) and in the laboratory (26). Fe^{59} allowed the amount of blood ingested by various insects to be determined (158). Differences in feeding habits of Hessian fly (Phytophaga destructor) larvae on both resistant and susceptible wheat seedlings (21) were investigated using P^{32}-labelled plants. The existence of different feeding regimes was established in larvae of Apanteles glomeratus L. parasitizing Pieris brassicae: at the last stage the insect switched from haemolymph to feeding on the host's fat (32).

The specificity of plant feeding was investigated in some mosquitoes when only 3 out of 24 (P^{32}-labelled) plant hosts proved acceptable (10).

Mechanism of feeding

Feeding mechanisms can have interesting bearings on plant damage by a particular pest and on possible disease transmission (23, 486-7, 489-91). Damage by the tarnished plant bug, Lygus lineolaris (P. de B.) was estimated in terms of the quantity of salivary secretion, using P^{32}, and the amount of fluid imbibed during feeding, using Ag^{110} and Ce^{144} (17-19). P^{32} was used to study intercellular and intracellular puncturing of plant tissue and the subsequent deposition of saliva by aphids (23-25). Aphis fabae Scop. could be shown to feed on phloem (16, 21-a). The mechanism of feeding of other aphids has been studied in detail (23-25).

Damage as a secondary effect of feeding, e.g. lysis of young plant tissue as a result of insect excreta, was found in maize (31).

Food transmission. Trophallaxis

Transmission of food is a complex process (39). The rate of food exchange varies with the species, the number of individuals, their social function, developmental stage, temperature, total time allowed, the quantity of food offered and available, and other factors (e.g. size differences between similar individuals).

The food, usually collected by "workers", has been shown to be transmitted to other members of a colony within a certain time, secondary transmission taking care of the distribution of available food throughout the colony. Much interesting work has been done on ants [8, 42; 43, 47 (P^{32}); 35-36, 38-39 (Au^{198})], termites [9, 45 (P^{32}); 46 (Co^{57}, Sr^{85}); 42 (I^{131})], bees [58 (P^{32}); 37, 39, 48 (Au^{198})], and wasps [60-61 (Au^{198})]. The location of the (labelled) food in the insect was determined (35), the quantity carried by individuals varying between wide limits (36). In some ants, e.g. Proformica nasuta Nyl., the tendency for independent and secondary food-uptake proved subject to marked individual fluctuations. Food intake appeared to increase with body size [49 (P^{32})]. The rate of food transmission differed markedly even in sub-families (42). In many species, individual participation in trophallaxis appeared to vary greatly with caste. In honey bees, Apis mellifera, where the most rapid trophallaxis takes place, queens, workers and drones were found to participate in it; drones proved capable of feeding themselves but preferred to be waited upon by the workers (42). Among wasps (Vespa), too, males had been observed to feed themselves (61) but this ability appeared to fluctuate with certain activities in the colony. Soldiers of the termite, Cryptotermes brevis, depended entirely on nymphs in the colony for being fed (46). Two kinds of trophallactic exchange, regurgitated food and saliva, were observed in another termite population, Cubitermes fungifaber (34).

---

* Nutritional requirements are considered in I; 1-8.

The first to receive saliva was the queen. In colonies of the bumble bee, *Bombus hypnorum*, the queen appears to participate actively in food transmission [44 (Au^{198})].

P^{32} showed food secretion in ants (*Formica polyctena* and *F. nigricans*) to be mainly formed in the pharyngeal gland and stored in the crop, and on stimulus to be released to male and female ants, larvae as well as workers (47). Food formation in nurse bees (62) was investigated by labelling with C^{14}. Not all larvae received food of the same quality. Those destined for sexual activity on reaching maturity were given preferential treatment in the quality and complexity of food made available to them. Even the quantity offered appeared to vary (61).

Neighbouring ant colonies are frequently inter-connected by subterranean passages. Radioisotopes may be used to determine the size, structure, location (55) and extent of such colonies (458), and interactions between them. Intensive food exchange between different nests of an ant colony has been observed up to 200 m (42) by labelling single nests. Food was shared unequally among inter-linked colonies of *Formica polyctena* (36). Transmission between colonies of different species (*F. polyctena* and *F. rufa*) was confirmed (35, 57). In a bee hive food is rapidly carried to the centre, with subsequent outward transmission (37).

Gradations in the ability to fend for themselves exist in different species and castes. Radioisotopes have served to throw some light on differences in group and individual behaviour (41, 42). In two species of ants and in termites (I^{131}-labelled) food proved to circulate longer in groups, due to trophallaxis.

Miscellaneous

Other aspects of behaviour studied included the mating behaviour of mosquitoes (53-4, 56) females mated with P^{32}-labelled males showed spermathecal radioactivity. P^{32} was also used to investigate the oviposition habits of the leafhopper, *Scaphoideus luteolus* Van Duzee (51).

A definite avoidance reaction to P^{32}-malathion baits was demonstrated in malathion-resistant houseflies (56). The reaction of *Aëdes aegypti* to repellent in blood varied with different concentrations (56).

The behaviour of pollinating agents (75, 77, 78; see also *Apis mellifera*) is now receiving increasing attention, and a marked rise in the number of publications may be expected in the future.

(2) Population dynamics

In studies on population dynamics a variety of radioisotopes have been used. Due to the number of factors which influence dispersal and migration, values tend to show considerable scatter, even within one experimental series. It is therefore essential to know the conditions under which particular values were obtained.

Some data have been summarized in Table I. P^{32} is used predominantly (e.g. for *Apis mellifera* 77-8; blowfly 80-1, 84, 93, 100, 1442; *Ceratitis capitata* 67, 72, 95-6, 766, 1452; *Lampronota nitida* 82; mosquitoes 53, 66, 69, 70, 461; etc.) although Co^{60} (463) and S^{35} have also been employed.

The effect of wind is not clearly defined (64, 70). The developmental stage (82), sex (66, 82), population density, availability of food, natural barriers (80, 84), temperature, and time of day are merely some of the factors which have to be considered. For example, one species required a minimum light intensity (0.2 Langley) for sustained flight (97). Two types of dispersal (81) have been observed: exodus, consisting of fast (200 yds at 7 miles/h or more) and sustained dispersal, and random dispersal where less or no net displacement occurs.

Flight ranges measured for different insects show a very wide variation. *Cnephalia cinerascens* (Rond.), a parasite of the grain Noctuid, *Hadena sordida* (Bkh.), has been known to cover 18-20 km in search of supplementary hosts (82). The record is held by a migratory moth which had become labelled accidentally, presumably by nuclear fission products, and is estimated to have covered the astonishing distance of 1500 miles (73).

Migration and dispersal may be of direct public health interest. Cockroach dispersion from sewer manholes was studied using P^{32}. Considerable attention has been paid to fly dispersal in urban and suburban areas (84), from inhabited premises (74), and especially from refuse dumps and garbage bins (68, 92, 457). P^{32} was also used to test the ability of synanthropic flies to cross water obstacles (93): a river ~500 m wide proved no obstacle.

Various species of blowflies (80) were found to disperse beyond a 50-yd belt of conifers and a 90-yd deciduous belt. Suburban dispersion was also studied in a Japanese city (84), the effects of natural barriers and a highway being noted. Due to their extensive breeding in the highlands, a special study of housefly populations was made in Malaya, with special reference to the Cameron Highlands (100).

Large scale (3×10^6) releases of *Aëdes taeniorhynchus* (66, see Table I) indicated maximum distances of 2 miles and 18 miles for males and females, respectively. Studies on *Anopheles gambiae* [69, 70 (P^{32}, S^{35})] showed mosquito movement to be non-random and related primarily to human settlements. Prevailing winds played a minor role.

A non-random distribution of foraging honey bees (*Apis mellifera*) was found to exist between apiaries (77). By mass-marking with P^{32}, the distribution of foragers from colonies placed in the middle of a large alfalfa field was found to be maintained for two weeks; a second group placed in the field later dispersed in much the same way (78).

Eurygaster integriceps Put. were labelled with Co^{60} for dispersal and population studies (89). By labelling larval stages with P^{32} vertical migration could be shown to be a function of temperature, and horizontal migration a function of the developmental stage. Mobility is evidently connected with the physiological condition as characterized by the fat index (63).

P^{32} permitted the movement of the black currant gall mite, *Cecidophyopsis ribis* (Westw.) (79) to be followed, and hibernation survival of two insects without diapause to be assessed (67).

Radioisotopes have been used for determining population density in blowfly (80) and ants (83, 1561), Co^{60} being used with *Eurygaster integriceps* in place of P^{32} (89).

(3) Disease transmission

The place of radioisotopes in entomological studies of endemic and tropical diseases in man has been reviewed in detail by several authors (480-1); the labelling of epidemiologically important arthropods is discussed in 482.

The natural ecology of such vectors requires careful study. Considerable work has been done on Rhodnius prolixus, the principal vector of Schizotrypanum (i.e. Trypanosoma) cruzi in Venezuela. Co^{60} was used for studying insect distribution in and out of doors (782). As a result, the concepts on its local behaviour required modification. In other work on R. prolixus H^{3} was used (301, 359).

Since fleas are known potential vectors of plague, data on their dispersal, migration, feeding activity and host-parasite relationships are being collected. In one migration study, rodents and their flea parasites were labelled with Sr^{89} (139), the host remaining radioactive for at least two months. Ectoparasite interchanges within a host population were studied using S^{35} (140)*. Seasonal effects on feeding activity (33, 141) indicated that spring epizootia of plague may be due to intensified feeding of fleas at that time, autumn fleas by virtue of their ecological indices assuring preservation of the plague bacillus for long periods. The predominance of females, with their higher feeding activity, indicates their significance in disease transmission (33).

Anopheles stephensi is known as the main vector of malaria in southern Iran (53). P^{32} was used in basic studies (53-4) on dispersal, mating behaviour, feeding, maturation of ovaries and length of gonadotrophic cycles.

Radioisotopes (P^{32}, Cs^{137}, I^{131}) were used for studying helminth life cycles, by allowing larvae transmitted by invertebrate hosts to develop in the (labelled) vectors Culex fatigans and Armigeres obturans (137).

The way in which animal disease is transmitted by blackflies (Simulium rugglesi) was studied on P^{32}-labelled duck-hosts (483).

Fly dispersal was studied in connection with the spread of dysentery and the eradication measures required (68).

Insect vectors play an important part in the transmission of diseases in plants. Pineapple wilt is caused by Pseudococcus brevis Ckll. Since this pest increases very rapidly when raised by the ant Pheidole megacephala (F.), a knowledge of the extent and structure of such ant colonies becomes of utmost importance in combating the disease and its spread. By labelling the ant with P^{32} such information can be obtained with precision, without causing any disturbance (458).

The transmission of plant viruses has received particular attention from Japanese scientists (488). Radioisotopes may be used not only to confirm transmission but also to throw light on the location of infective material within the insect. The transmission of dwarf disease of rice by the green rice leafhopper, Nephotettix cincticeps Uhler was confirmed with the aid of P^{32} (485). Following feeding on S^{35}-labelled diseased rice plants, radioactivity was concentrated in the Malpighian tubules. In another study (486), P^{32} was used in an attempt to establish host preferences of the green peach aphid, Myzus persicae Sulzer, known to be a vector of the Daikon mosaic virus. A study on four species of aphids showed the extent of virus infection and the rate of transmission to vary with the species (491). In the course of work on the varietal resistance of garden crops to virus disease, mosaic virus transmission by three further species of aphids was traced with P^{32} or S^{35} (490); S^{35} was identified in the rostrum, pharynx, salivary gland, and alimentary canal of the aphid.

The acquisition and transmission of aster yellows virus by the aster leafhopper, Macrosteles fascifrons (Stål), was related to the feeding site (487). Transmission peaks occurred.

P^{32} and S^{35} were used to study the fate of turnip yellow mosaic virus in the non-vector aphid Hyadaphis brassicae (L.) (444). Virus appeared to persist intact in the gut for several days.

(4) Insect-host relationships

The significance of the microorganism-insect relation in insect nutrition has been reviewed (134). C^{14} was used to clarify the role of intestinal symbionts in cellulose metabolism (135) and in sterol metabolism (373), and of intracellular symbionts in amino acid synthesis (232).

Identification of some predators was achieved by labelling their prey (the pink bollworm, Pectinophora gossypiella (Saund.: 136)) and of parasites by labelling the host (e.g. Noctuidae: 82, 138). P^{32} was also used for studying the parasitization of Pieris brassicae by Apanteles glomeratus (32).

In an investigation of the host-parasite relation between Mallophaga and its chicken-host Fe^{59} was used (484), injected intravenously into the chicken.

A number of studies published on rodent-flea relationships (33, 139-141, 459, 462) have already been mentioned. (For other parasitic relationships, see under I-C Insect Labelling).

The life cycles of two helminths, Wuchereria bancrofti and Setaria digitata were studied in their P^{32}-labelled mosquito vectors, Culex fatigans and Armigeres obturans (137).

Food chains

The degree of transfer of fission products through plant to insect food chains (104-6, 116), relevant herbivore-predator relationships, the accumulation of radionuclides within the insect*, possible changes with time in the radionuclide distribution within a particular ecosystem, and the radioactive contamination of adjacent land by the dispersal of aquatic insects from contaminated water bodies (123-4, 126-7) have been receiving a great deal of attention**.

Surveys were made of the relative concentrations of β-emitters in parts of the Columbia River (114); aquatic insects within the Hanford Reservation below the reactor were found to concentrate P^{32}, Cu^{64}, Cr^{51}, Zn^{65} and Na^{24}.

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* See also 459, 462.

* The possibility of using certain insects as monitors of radioactive contamination has been considered.

** For radiation effects on aquatic insects see 108-12, 117-9, 122.

Interspecies differences in radionuclide accumulation were influenced by ecological and metabolic factors (115). Radionuclide accumulation has been widely studied (104, 167, 183-4) for a variety of radioisotopes, amongst them P^{32}, S^{35}, Fe^{59}, Zn^{65}, Sr^{90}, Y^{91}, Ru^{106}, Ag^{111}, I^{131}, Cs^{137}, Ce^{144}, Pm^{147} and Hg^{203}. The larval build-up factor varied from one to thousands depending on the element, with some species variation (184). Many differences could not be explained by size differences (relative growth and metabolic turnover) only (104). (See also 128-30 for the specific accumulation of individual radionuclides in fresh-water insects).

INSECT BIOCHEMISTRY AND PHYSIOLOGY

Examples have been selected to illustrate ways in which radioisotopes have been employed in research on various topics of insect biochemistry (412) and physiology.

Numerous studies have been published on the uptake, accumulation, distribution and elimination of individual radioisotopes or elements (154-7, 164-5, 167). Radioisotope excretion rates served as indices of certain metabolic rates (174).

The persistence, decay and distribution of P^{32} were investigated in grasshoppers and the Madeira cockroach (171). Other studies were concerned with its incorporation into phosphorus compounds of wax moth larvae (185), its uptake by various organs of locust (152) and by different stages of a mosquito (153), and with the transmission to descendants of P^{32} incorporated in the (Drosophila) parents (162-3).

The accumulation of Zn^{65} in mosquito was found to be 5 - 10 times higher than for other trace elements (172). Data are available on its distribution, persistence, genetic effects and effects on reproduction in wasps (168-9).

The distribution and retention of yttrium (Y^{91}) in flies was found to vary according to whether yttrium had been administered by injection (175) or ingestion (176).

Great variability in the localization of iron (Fe^{59}) in tissue and its association with cellular components occurred in Chironomus plumosus (177). Assimilation and elimination rates were studied at nymphal and adult stages of Triatoma infestans (Klug) (159).

The kinetics of sodium transfer have been studied intensively; both Na^{24} and K^{42} have been used a great deal in work on the insect nervous system (429, 431, 433-7).

(1) Carbohydrates

C^{14}-glucose was used in the majority of investigations on carbohydrates, e.g. on metabolic conversions during pupation in the Cecropia silkworm, particularly the deposition and utilization of nutrient reserves with reference to the larval cuticle (187). Information was also obtained on the carbohydrate metabolism in silkworm pupae following injury (151) and on some biochemical changes associated with larval growth and development in the blowfly, Phormia regina (Meig.) (202).

Some aspects of intermediary carbohydrate metabolism were studied in Triatoma infestans nymphs (186) and in the desert locust, Schistocerca gregaria Forsk. (193). Biosyntheses of glucosides and glycogen were also studied in the locust (200).

A great deal of work has been done on Periplaneta americana. Mucopolysaccharides were studied during moulting (196); mole ratios of bound carbohydrates were found to vary throughout the entire moulting cycle. Polysaccharide and glycoprotein formation (197), glucose catabolism in DDT-treated insects (199) and glycogen synthesis in insect fat body (201) were investigated. The level of inorganic phosphate proved rate-limiting for anaerobic glycolysis in muscle tissue of the cockroach (194). Trehalose is of considerable interest from various points of view; its biosynthesis (427) was studied in the fat body of locust (189) and of blowfly (190), where the concentration of blood trehalose was found to determine the rate of energy expenditure during flight (190-1). A study on the exchange and metabolism of sugars in the central nervous system of cockroach (430) indicated rapid conversion of glucose to trehalose (see p. 19).

Silverfish, Ctenolepisma lineata, was found capable of digesting cellulose without the help of symbionts (195) which proved necessary, however, in cricket and locusts (135).

(2) Amino acids and proteins

Nutritional requirements throughout their life cycle, and the composition and synthesis of their amino acids have been studied in a variety of insect species. Radioactive amino acids have been used widely in order to study protein turnover and synthesis. Some examples will be given.

Some amino-acid requirements of the green peach aphid, Myzus persicae (Sulzer) were determined by means of C^{14}-glucose (291). The important role played by intracellular symbionts of Blattella germanica in amino acid synthesis (134) has already been mentioned (p. 11). Amino acid requirements were also studied in nematodes (1587), in the pale western cutworm, Agrotis orthogonia Morr., (247), and the prairie grain wireworm, Ctenicera destructor Brown, (248). Nutritionally essential and non-essential amino acids were determined. The utilization of C^{14}-labelled protein was also investigated in Agrotis (225).

Amino-acid incorporation in larvae of Drosophila melanogaster was studied (285) by injecting C^{14}-labelled amino acids into the haemolymph. Very rapid incorporation into peptides was observed (286). In vitro incorporation of amino acids into proteins of Drosophila pupae was followed by means of C^{14}-leucine (239) and H^3- and C^{14}-leucine in cell-free preparations (223). Amino-acid metabolism (266) and the effect of anoxia on it (267-8) were studied in the adult housefly by means of [2-C^{14}]acetate. In the roach, Periplaneta americana (221), a quantitative comparison was made between amino acids in haemolymph from DDT-poisoned and from DDT-treated but symptom-free insects.

The metabolism of sulfur amino acids (210) and of related compounds (230) was studied in Blattella germanica, using S^{35}-cystine, cysteine, cysteinesulfinic acid, taurine, methionine, methionine sulfoxide, methionine sulfone, and C^{14}-serine. Similar studies on the blowfly, Phormia regina (Meig.), revealed (231) that, unlike B. germanica (210), P. regina was incapable of using sulfate in the synthesis of S-containing amino acids. The effect of the intracellular symbionts of B. germanica was studied using glucose-U-C^{14} (232), and once more (210) illustrated their necessity for the synthesis of cystine and methionine from inorganic sulfur. Some data on the cystathionine pathway in B. germanica were obtained, using S^{35}-cystathionine (233), and in some species of silkworm (250) using DL-methionine-S^{35}.

Tyrosine metabolism, studied intensively in a number of species, has been reviewed by Brunet (204) and Karlson (206) who also published a series of papers (240-4; see also 278-9). The incorporation of tyrosine metabolites in the puparium (240) and the incorporation of [α-C^{14}]N-acetyl-depamine and generally labelled N-acetyl-tyramine (241) into the cuticle were studied in the blowfly, Calliphora erythrocephala. N-acetyl-dopamine was subsequently concluded to be the phenolic precursor of the sclerotizing quinones (see also 280, 245). The biogenesis and fate of the acetyl group of N-acetyldopamines was studied further (244). The C^{14}-labelled acetyl grouping was incorporated into the cuticula during sclerotization. The catabolic degradation of tyrosine and the biogenesis of N-acetyldopamine are discussed in 278. Hydroxylation of tyrosine to dopa, decarboxylation of dopa to dopamine, and N-acetylation of dopamine to N-acetyldopamine formed intermediate steps in the biosynthesis of N-acetyldopamine (280). The purification, properties, and substrate specificity of dopa-decarboxylase were investigated, using a C^{14}-labelled substrate (279).

The control of tyrosine metabolism by ecdysone was studied in developing Calliphora larvae with generally labelled preparations, L-[C^{14}]tyrosine, and L-[2'-C^{14}]dopa (243): ecdysone appeared to induce decarboxylating enzyme. Periplaneta americana proved able to synthesize protocatechuic acid from either generally labelled tyrosine or glucose-C^{14} (217).

A great deal of research on amino acids and proteins has been done in silkworm. The incorporation of valine-1-C^{14} into proteins of the Cecropia silkworm (289) was confirmed in various tissues and cell fractions (296), and of acetic acid-C^{14} into silk proteins of Attacus ricini (253). The mechanism of fibroin biosynthesis based on its chemical structure (264-5) was considered in a series of papers; the kinetics of fibroin synthesis were analysed in 282. C^{14} and P^{32} labels (254) were used in order to correlate fibroin synthesis with RNA metabolism (254). A further* series of papers dealing with biochemical studies on the amino acid composition of fibroin in Bombyx mori has been published by Bricteux-Grégoire et al. (213-6), C^{14}-labelled compounds being used throughout. Glycolic acid(1-C^{14}) appears to be used for glycine formation via glyoxylic acid (227, 236), the reaction playing an important part in larval glycine synthesis. A study on the metabolic pathway of amino acids in silkworm larvae in relation to silk production (237) showed synthesis of glyoxylic acid from citric acid(-1, 5-C^{14}) to take place via the glyoxylate cycle. Studies on the biosynthesis of glycine in the silkworm indicate a direct conversion of serine(-1-C^{14}) to glycine (261, see also 214); the conversion of glyoxylic acid to glycine in the intact silkworm was traced using glyoxylic acid-1, 2-C^{14} and glycine-C^{14} (262). A variety of studies on protein synthesis (256-60, 269-70, 274, 276-7, 281, 292-3, 295, 297) have been reported, including work on particulate fractions in cell-free systems (256-8, 296-7).

Some work is reported on yolk formation (209) where protein synthesis in the ovary of Calliphora erythrocephala Meig. was studied by means of H^3-L-histidine. Chromosomal syntheses of protein were investigated, using S^{35}- and C^{14}-labelled methionine and H^3-leucine (288). RNA synthesis was shown to precede protein synthesis in Tribolium confusum (222).

Other investigations dealt with such topics as juvenile hormone in Samia cynthia (275), the role of the gonadotropic hormone in protein synthesis (301) in Rhodnius prolixus, and the biogenesis of ecdysone in Calliphora were cholesterol proved to be the precursor (246). The study of acetylcholinesterase activity over a wide range of substrate concentrations was facilitated by radiometric methods (303-4; see also 302).

(3) Nucleic acids

Asynchrony and differential rates of DNA synthesis in hetero- and euchromatin were confirmed in various Diptera (311), heterochromatin lagging behind in the meiotic chromosomes of grasshopper (325). The heterochromatin contained 2 - 3 times more DNA per unit area than euchromatin (326). Heterochromatic DNA, as derived from the Y-chromosome of Drosophila did not contain any associated RNA (334). In mealybug, Pseudococcus brevis, DNA synthesis in euchromatin occurred during the first half of the synthetic period, replication in heterochromatin in the second half (308).

The synthesis of DNA (in the nuclei of the ovary, fat body, and midgut of Rhodnius prolixus) and protein (mostly in the ovarian follicular epithelium and the fat body), and their transport were studied in the course of vitellogenesis (359). Nucleoside incorporation in DNA was studied in cricket ovary (315), as were variations during vitellogenesis. Accumulation of DNA reserves in oöcyte cytoplasm of Coreus marginatus was investigated using H^3-thymidine (318).

Investigations on salivary gland chromosomes and their organization (361) revealed different physiological conditions along their length (343); differential DNA-replication was observed in Chironomus thummi (322) and in meiotic chromosomes of grasshopper spermatocytes (327) DNA synthesis was found to occur at specific segments. Discrete points of synthesis were also indicated along polytene chromosomes in Drosophila (338). The apparent absence of DNA in interbands was deduced from quantitative autoradiographic data (357). Two kinds of DNA were found in Chironomus plumosus: one associated with the chromonemata, the other in the nucleoplasm surrounding the chromosomes and, in some cases, apparently extruded from the nucleus into the cytoplasm (340). A thymidine "pool" in grasshopper neuroblasts gave results supporting intracellular presistence of thymidine derivatives between periods of DNA synthesis (324).

DNA metabolism in pupal tissues was studied in some saturniid Lepidoptera (323) and in Diptera (342). Some chromosome regions seemed still capable of synthesizing DNA during digestion in the pupae (342), DNA synthesis thus apparently not being related to multiplication of chromonemata.

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* See preceding volume (Bibliographical Series No. 9).

Some genetic effects induced by labelled DNA precursors have been observed (475, H^3; 477, H^3,C^{14}).

RNA and the control of cellular processes have been reviewed by Zalokar (363). Synthesis and breakdown of proteins and RNA were studied in Tribolium confusum (222). Isolated polytene nuclei of Rhynchosciara angelae and controls showed a similar pattern of nucleoside incorporation but differed for amino acids (351); the effects of various pre- and co-treatments were examined (352). Differential RNA synthesis was observed for the X-chromosome and autosomes in male locust (319). The role of gonadotropic hormones in RNA synthesis was studied in Rhodnius prolixus (301). Experiments with DL-leucine-4, 5-H^3 and uridine-5, 6-H^3 on Drosophila showed the cytoplasm to be the main site of protein formation (362), confirmed in Smittia (347). Further data in support of the hypothesis of a nuclear origin of RNA were obtained (362).

The role of the nucleolus in RNA synthesis was studied in oöcytes of Blattella germanica (364). It is suggested that nucleoli serve for intermediate storage or as a processing place for a certain kind of RNA from particular regions of the chromosome. Synthesis of nucleolar RNA, studied in Smittia (349), appears to begin in the nucleolus proper and is dissociable from the synthesis in the nucleolar organizer (355).

RNA metabolism was investigated in pupal tissues of saturniid Lepidoptera. Malpighian tubules, nervous tissue and haemocytes of Hyalophora cecropia synthesized RNA at a significant rate whereas all tissues of non-diapausing Samia cynthia synthesized RNA throughout the pupal stage (323). Synthesis rates vary with the tissue.

Earlier results on the composition of RNA from Lepidopteran silk glands were confirmed in a study on metabolism (310). Synthesis, intercellular transport, and breakdown of RNA were studied in the ovary of the housefly (312) and of the cricket, Gryllus bimaculatus (313, 314). At 5th instar, a RNA with a rapid turnover appears to be synthesized in the silk gland of Bombyx mori (321), with a base composition different from that of a ribosomal RNA but resembling that of DNA. No such RNA was observed at a later stage. The metabolic characteristics of nucleolar, chromosomal and cytoplasmic RNA in salivary glands of Drosophila were studied by analysis of the incorporation and retention of adenine-8-C^{14} and $P^{32}O_4$ (332-3). Two types of DNA-associated RNA were distinguished in Drosophila (335).

An extrinsic and an intrinsic nucleolar RNA were demonstrated in a study on the relation of messenger to nucleolar RNA (350), the extrinsic being chromosomal RNA. Messenger primes nucleolar RNA. Free messenger RNA was observed in the nucleus and followed to the cytoplasm. The synthesis of messenger RNA was studied in polytene chromosomes of Dipteran salivary gland (317), using H^3-uridine. H^3-labelled precursors showed puffs in the midge Chironomus to be active centres of chromosomal RNA synthesis (309).

(4) Pigmentation

Several studies have been reported on pterins and leucopterins. Experiments on Drosophila (211-2) have shown that the C atoms of glucose are

specifically used to build up the pyrazine ring of the pterins. A synthesis of biopterin-2-C^{14} is described in 271. The metabolism of biopterins in the honey bee was studied in queen bee and worker larvae, through pupation to the imago. The biosynthesis and structure of leucopterin were studied in pupae of the cabbage moth, Pieris brassicae (305-7). In biochemical studies on cuticle pigmentation in Gryllus bimaculatus de Geer and Locusta migratoria, S^{35}- and C^{14}-labels were used (228-9). Yellow wing pigments were studied in papilionid butterflies (299, 300).

(5) Sterols and lipids

Insects generally have been found to require a dietary source of sterol for normal larval growth and metamorphosis, which implies some enzyme deficiency for sterol synthesis. In the housefly, a dietary source of sterol proved essential also for sustained viable egg production, cholesterol being involved in mobilizing and utilizing nutrient reserves associated with the initiation of ovarian maturation (395). The nature of housefly sterols (365-6) and their metabolism (367) has been studied in some detail, frequently with cholesterol-4-C^{14}. Cholesterol metabolism was further studied in cockroach (367, 381). The presence of at least three functionally distinct sterol pools was indicated in the tissues of Eurycotis floridana (387). A general procedure for the isolation of its sterol esters was given (368). Dietary cholesterol was efficiently utilized in Blattella germanica, more than 90% of the ingested sterol being retained (393). The fate of dietary H^3-β-sitosterol in the nymphal roach and in adult housefly (383) showed considerable differences. Some data were obtained on essential cholesterol requirements of cockroach (E. floridana) tissue (374) and on the role of intestinal symbionts in the sterol metabolism of B. germanica (373).

The sterol esters of housefly eggs and their fatty acid content have been analysed (379). In a study on sterol utilization by the hide beetle, Dermestes vulpinus (376), the structure of various sterols and their cholesterol-sparing efficiency were correlated. The conversion of cholestanol to Δ^7-cholestenol was studied in cockroach (389).

A study of steroid biosynthesis in silkworm (396) suggests C^{14}-acetate to be a precursor of sterol in pupae in the same way as in mammals. Biosynthesis of cholesterol was confirmed in silverfish, Ctenolepisma (375); it failed to be confirmed in another primitive insect, Thermobia domestica (384). Cholesterol metabolism was studied in the rice moth, Corcyra cephalonica (392). The previously reported absence of sterol synthesis from C^{14}-acetate in adult housefly proved not to be due to a metabolic block in the biosynthesis pathway between acetate and mevalonate (382); the whole sterol-synthetic pathway is probably lacking. Larvae of aseptically reared blowfly (Calliphora erythrocephala) were unable to synthesize cholesterol from acetate or to synthesize or use squalene in its place (397).

A micromethod for tritiating steroids has been described (385).

The main differences between housefly and mammal phospholipids appear to be low plasmalogen content, absence of sphingomyelin, occurrence of a sphingolipid containing phosphorus, and the predominance of phosphatidylethanolamine (378). The biosynthesis of phospholipids in insects was studied in selected moths in terms of their incorporation of P^{32}-phosphocholine (370) and P^{32}-orthophosphate (371-2), and synthesis and lipogenesis from C^{14}-acetate in cockroach (388, 404) and the boll weevil (386). Phospholipids, particularly those of the thoracic ganglion, were studied in dieldrin-resistant and susceptible houseflies (369). Two phospholipid components were found to be stable to hydrolysis with mild alkali and acid (377).

The biochemistry of the insect fat body was reviewed by Kilby (427). The *in vivo* synthesis of fatty acids was studied in the green peach aphid (400) and in the fat body of the moth *Prodenia eridania* (406) which contains a system enabling acetate to be incorporated into long-chain fatty acids (predominantly palmitic acid). The biosynthesis of fatty acids was investigated in aseptically reared blowfly larvae (398). The rate of fatty acid synthesis was found to be 2.5 - 4.7 times greater in male than in female cockroach (388). Fat synthesis in cell-free preparations of fat-body (402) and fat transport were studied in locust (401).

(6) Nervous system

Functional aspects of the organization of the insect nervous system have been reviewed in the light of recent work (429). Nucleotides and other phosphorus compounds of the central nervous system (CNS) of cockroach were studied by means of the labelled pool technique using P^{32}-orthophosphate (421-2). Concentrations of the various compounds in the abdominal nerve cord were comparable to those found in mammalian nervous tissue except that cytidine and uridine nucleotides were higher (422). The amount of phospholipid in cockroach nerve was similar to that in mammalian peripheral nerve. Permeability and perilemma function were studied by observing the uptake of some C^{14}-labelled molecules by the abdominal nerve cord of *Periplaneta americana* (411).

The exchange of Na ions and Na^{24} efflux from isolated abdominal nerve cord, single connectives, and ganglia (433-6) were studied in the roach. An initial fast phase was attributed to a rapid diffusion from extracellular space, demonstrated with C^{14}-inulin, a second (rate-limiting) phase being interpreted as slower extrusion from tissues lying at a deeper level in the CNS (432). Na appears to be extruded from the nerve cord by a metabolically maintained secretory mechanism which is also associated with the uptake of K (432-3), an earlier (431) calculation of ionic fluxes being based on an oversimplification. The efflux of tritiated water from the ligated nerve cord also occurred as a 2-stage process. By means of Na^{22}, Na^{24}, K^{42}, Ca^{45}, Cl^{36} and $H^{3}OH$ the levels of the various ions in the extracellular fluid could be shown to differ markedly from those in the external medium, the cations being more and the chloride ions less concentrated (437). The efflux of Na^{24} from desheated terminal abdominal ganglia was also found to approximate to a 2-stage process. The rapidly exchanging fraction (identified with the ions in the extracellular spaces) represents ~ 1/3 of the total exchangeable Na in the ganglion. The extracellular space was measured using C^{14}-inulin, and could be shown to contain 18.2% of the ganglion water (436-7). The concentration of Na ions in the extracellular fluid exceeded the concentration in the haemolymph and cellular Na by factors of 1.8 and 2.5, respectively.

The transfer of substances between the blood and the CNS was analysed, particularly with reference to exchanges of labelled (C^{14}, Na^{24}, K^{42}) sugars with the haemolymph, the size and structure of the extracellular space, and the composition of the extracellular fluid as compared with the haemolymph (438). Injected C^{14}-glucose was rapidly converted to trehalose; 90% of the carbohydrate material crossed the perilemma as large trehalose molecules, the glucose molecules passing at 2.5 times the rate of trehalose. Results indicated the existence of the Krebs tricarboxylic-acid-cycle enzymes in the CNS (430).

Cholinesterases in insect muscle innervation were investigated in several species, with special reference to the insecticidal effects of DDT and DFP (420). The toxic effect of DDT apparently results from modified permeability and not cholinesterase inhibition. Moderate DDT poisoning reduced K^{42}- (but not Na^{24}-) uptake by peripheral nerves and ganglia from surrounding aqueous media.

(7) Tissues and organs

It might be of interest to consider briefly some of the tissues and organs which have been studied.

Cuticle

The biochemistry of sclerotization has been the subject of numerous studies (e.g. 241-2, 245, 280 on *Calliphora erythrocephala*). Chitin synthesis was investigated in the locust *Schistocerca gregaria* (218), chitin synthesase in cell-free extracts of *Prodenia eridania* (238). Penetration rates into cockroach cuticle were found to increase with the polarity of the compounds in tests on certain inorganic salts and insecticides labelled with C^{14} or P^{32} (428). In a soil insect K^{42} penetrated the cuticle more rapidly than P^{32} (178). A one-sided permeability was observed for the salts tested. The spread of oil films and the penetration of oily solvent (1555, H^3; 1553-5, I^{131}) and C^{14}-insecticide (1555) were studied on blowfly cuticle.

Haemolymph

Investigations on its chemistry included an analysis of acid-soluble compounds in the haemolymph plasma of several Lepidoptera by means of ion-exchange chromatography (440) and P^{32}. Attempts were made to determine changes in haemolymph volume during the moulting cycle of *Periplaneta americana* (439). A possible explanation of the patterns in average total haemocyte counts observed in grasshopper (414) was put forward.

Fat body

Its complex biochemistry (427) and some studies (e.g. 402, 406) have already been mentioned. Some work has also been done on glycogen (201) and trehalose (189-90) synthesis, and on protein and nucleic acid syntheses (359, 273) in the fat bodies of various species.

Reproductive tissue

The metabolic activity of ovarian tissue has been analysed in a variety of species with regard to phosphate metabolism (23), nucleic acid metabolism (313-5, 345-6, H^3; 348, 426, C^{14}) and yolk formation (209, H^3). Absorption and subsequent breakdown of C^{14}-urea was studied in diapausing eggs in *Acheta commodus* (Walk.) (423).

Tritiated thymidine was used to time the spermatogenetic cycle in *Drosophila* (418).

Silk gland

The mechanism of protein synthesis, and particularly the role of RNA in governing synthesis have been studied in the silk gland of various species of silkworm. The gland is an organ of exceptionally high RNA content. Much of the work was done on *Bombyx mori* by means of C^{14}-labelled substances (256-62, 269, 270, 274, 276-7, 292-3, 296-7, 310), particular attention being paid to fibroin synthesis (213-6, 254, 264-5, 270, 277, 282-4, 292, 295) and its composition.

Salivary gland*

The use of radioisotopes in studying salivary gland function is reviewed in 413. The structure and function of giant chromosomes in the salivary gland of various Diptera (e.g. *Chironomus plumosus* 309, 322, 337, 339, 340; *Rhynchosciara angelae* 316; *Simulium* 341; *Drosophila* 342) were studied by means of tritiated compounds. Differences in physiological condition of the chromosomes along their length, puff formation, and sites and sequence of RNA and DNA syntheses (317) were some of the problems analysed.

INSECTICIDES

The application of radioisotopes in insecticide studies has been widespread and varied (684, 657, 550), ranging over such aspects as synthesis and biosynthesis, insecticide composition, purity, degradation products, insecticide metabolism (including insecticide uptake, translocation, tissue distribution and excretion), in insects, other animals and plants, toxicity, persistence and residue analysis, and soil sorption. C^{14} and P^{32} are the most frequently employed radioisotopes although others, e.g. Cl^{36}, Br^{82} and I^{131}, have also been used. Relevant studies have been summarized in Table III.

There are a number of major practical difficulties in assembling documentation on radiotracer studies on insecticides. First, growing sophistication with regard to radioisotopes which have now for some time been a familiar tool for this type of research has led many authors to omit all mention of radioisotopes in their titles and, frequently, even in the abstracts. As a result, there is an increasing need for consulting original articles rather than to rely on abstracting journals, particularly when no detailed cumulative index of the type supplied by Chemical Abstracts is available at the time of consultation. Furthermore, abstracts are not necessarily very informative on the methods and tools used in a particular study. Secondly, there is a very marked diffusion of the literature over a large variety of publications; apart from certain major journals, scanning has to be very wide and the yield is relatively poor. Thirdly, information assembled on insecticides must inevitably be considered to be very incomplete since many industrial laboratories which are very active in this field do not permit their work to become available to the general scientific public. One further difficulty lies in the task of keeping abreast of current and past development on chemical control measures. There is still some confusion over the identities of certain compounds. A very large number of commercial and experimental compounds are and have been tested and used, and have become known under various synonymous chemical or trade names. When results were first published a coded number may have been used, to be followed by an abbreviated chemical name or some other incomplete designation. A table has therefore been set up (Table III) in which chemical names and other designations are given for insecticides cited in this bibliography (see Kenaga's "Commercial and Experimental Organic Insecticides", 1963 revision, in *Bull. ent. Soc. Amer.* *9*, 2 (1963) 67-103). Where chemical names are in accordance with the principles of Chemical Abstracts this is indicated. The tabulated data have been assembled in separate categories, i.e. botanicals and derivatives, chlorinated aryl hydrocarbons (containing 6 or more chlorines), DDT relatives (diphenyl aliphatics), fumigants, heterocyclic compounds, phosphorus-containing compounds [aliphatic derivatives, aryl(phenyl) derivatives, heterocyclic derivatives], radiomimetic agents (chemosterilants)*, sulfonates, carbamates and miscellaneous. Corresponding tracer studies on insecticide metabolism, synthesis and properties, and residue analysis are tabulated, together with the radioisotope used. Two special indexes (a common and manufacturers' name index and a letter-and-number index) of insecticide references have also been prepared.

IONIZING RADIATIONS AND THEIR APPLICATIONS

The effects of ionizing radiations on insects may be broadly divided into genetic and cellular effects (II:I-A), and effects on development and on the organism (II:I-B). At the present time there are two main ways in which radiation may be harnessed for insect control: by using its genetic effects, as has been done in the sterile-male technique (II:II-B), and by using doses that are either lethal or capable of interrupting the life cycle, such as would lend themselves to routine disinfestation of, for example, stored commodities (II:II-C).

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* A review of the vast amount of work based on the salivary gland chromosomes of *Drosophila* (e.g. 832) is clearly outside the range of this discussion.

* Chemical control measures by means of chemosterilants are receiving increasing attention, and some interesting results have been obtained for mosquitoes and also such insects as the screwworm, the house- and the stable fly. Only those papers have been included in which radioisotopes have been used in the course of testing the chemosterilants, e.g. P^{32}-metepa (735, 737), and papers in which chemical and radiation-induced sterilization have been compared, e.g. sterilization of *Drosophila* (1169, 1172) and of mosquitoes (1178, 1180, 1378).

(1) The sterile-male techniques

The sterile-male technique consists basically of the mass rearing and release of males which have been sterilized or which carry a dominant lethal factor resulting from exposure to ionizing radiation (usually γ-rays); the native population is then overflooded repeatedly until the desired effects are achieved. Following the highly successful eradication of the screw-worm fly, Cochliomyia hominivorax, from Curaçao and the southeastern United States the sterile-male technique caught the imagination of scientists all over the world. An ever increasing number of pests is being investigated (see II:II-B), to determine whether the technique would be feasible for their eradication or control.

Considerable research is necessary before radiation can be employed as an effective autocidal technique in any one species. Radiosensitivity varies with the species, the stage, and sex (II:II-A. 10, 2; B. 1, 8). The optimum stage for irradiation has to be determined, and is usually found to be at the pupal or adult stage when the imaginal tissues have differentiated and cell division is most active in the gonads. Dose rate and dose fractionation have a marked effect on lethal dose and recovery phenomena, the degree of recovery being a function of dose, the interval between successive doses, the extent of fractionation, and the temperature at which insects are maintained before, during and after irradiation. Temperature effects such as occur when there is a high population density at the time of irradiation must also be taken into account. Doses must be standardized, and administered under controlled conditions of aeration, etc. A suitable irradiation procedure must therefore be established for a particular species, capable of producing the desired effect (sterilization, dominant lethal factor) whilst ensuring good survival, and the vigour and ability to compete effectively with the normal males. Much of the preliminary research data is found in part II: I Basic Research, under Genetic and Cellular Effects, where dominant lethality, sterility, and cell killing (A. 2), mitotic and meiotic stage sensitivity (5), modifying factors (6), and genetic effects on different species, strains and lines (7) are considered. Developmental effects of radiation (II:I-B. 1) vary with a number of factors, such as age, the intensity of irradiation, conditions during treatment, etc. The effects may range from delayed to inhibited development or even death, and from minor anomalies to major detrimental malformations (B. 2). Some deformation is often found in the insect wing. Malformations have been observed in Blaberus craniifer (1266), Diatraea saccharalis (1434), Ephestia kühniella (1237, 1244, 1250), Laphygma frugiperda (1434), Tenebrio molitor (1238), Tribolium confusum (1298, 1300-3, 1367-8), Trogoderma granarium (789, 1238), and others. Radiation may cause changes in behaviour, for example, with regard to feeding, stinging, mating, orientation, pigmentation or affect the structure or physiology of certain tissues (B. 3), [e.g. the ovarian organs, as in Cochliomyia hominivorax (1265), Dacus oleae (1185), Drosophila melanogaster (1169), Habrobracon (1307, 1361), and Trogoderma granarium (1238)].

Effects on aging and longevity (B. 5), [e.g. Drosophila pseudoobscura (1384), Tribolium confusum (778, 1372)] are of great importance in testing sterilized males for their effectiveness in the field. Differences in the susceptibility of different species (B. 8) also require attention.

A through knowledge of the habits and ecology of the species under consideration is therefore essential. Data on dispersal under prevailing conditions, the effectiveness of existing natural barriers (in the region to be controlled), mating habits, the number of annual generations, seasonal fluctuations in population density, the duration of different stages under given conditions, and the rate of emergence in natural habitats are just some of the questions that need to be answered before any control measures by means of the sterile-male technique can be envisaged. Very useful information can be obtained by means of radioisotopes on dispersal (see Table I), population density (80, 83, 89, 1561), the distribution and longevity of irradiated insects, mating behaviour (53-4, 56, 1375) etc. (see I:I-A. 2c, 3).

Table II summarizes data obtained on the radiation-induced sterilization of forty-two species of Coleoptera, Diptera or Lepidoptera, together with the radiation and dose employed for a particular stage. Radiosensitivity can be seen to differ widely. Thus, x- and γ-ray doses of only 3000 r and 3200 r will sterilize pupae of the housefly (812) and numphs of the German cockroach (1354), respectively, whereas 15 000 r of γ-radiation (789) are required to sterilize the Khapra beetle. Sex differences in radiosusceptibility are very noticeable in the beet armyworm, Spodoptera exigua, where female pupae only require 5000 r for sterilization against 9000 - 11 000 r for males (810). Sterilization doses for mosquitoes vary very considerably with the species. Thus adults of Anopheles maculipennis atroparvus may be sterilized with only 6000 r of x-radiation, whereas 8865 - 12 900 r of γ-radiation are required for A. quadrimaculatus (1180, 1446); Culex fatigans requires only 7700 r (1447) against 11 000 - 18 000 r for Aëdes aegypti (1444). The influence of age on susceptibility (at a particular stage) is very marked in, for example, Ephestia kühniella where the sterilization dose ranges from 10 000 to 30 000 and 60 000 rad (1235, 1468), depending on the age of the male pupae which are irradiated at 3, 6 and 15 d, respectively. The effect of varying such factors as temperature (1357-8, 1060, 1076, 1080, 1103, 1106, 1158-9, 1161, 1163) and the composition of the environment during irradiation (1045, 1055, 1075, 1116) are also brought out.

The sterile-male technique has for some time been of particular interest to the IAEA. Two panels on the sterile-male technique have been held at the IAEA, one in 1962, and another in 1964. A comprehensive report on the first panel, No. 21 in the Technical Report Series, was published in October 1963; the second panel report, No. 44, will be published in the same series in June 1965. In 1962, nine countries (Australia, Belgium, Canada, France, Greece, Israel, the United Arab Republic, the United Kingdom, and the United States of America) were represented, with delegates from the Food and Agriculture Organization and the World Health Organization. In 1964, Costa Rica, El Salvador, Italy, Southern Rhodesia and Tunisia were also represented, indicating the increasing interest in the subject throughout the world. A large number of species is being considered for possible inclusion in sterile-male release programmes (1434): The Australian sheep blowfly, Lucilia cuprina

(Wied.), which has proved rather unpromising; the New Guinea screw-worm, Chrysomyia bezziana Villen, also unpromising at present; the tropical ox warble, Dermatobia hominis (Linn.), of Latin America, where the aspects are promising; the tsetse fly, which shows promise (those of the 25 species of Glossina known to be vectors of trypanosomiasis are of particular interest); the Mediterranean fruit fly, Ceratitis capitata (Wiedman), where encouraging results have already been obtained in field trials on Hawaii and Costa Rica (1452-3), important research also being carried out in France, Israel, Tunisia and the UAR; the Mexican fruit fly, Anastrepha ludens (Loew), where mass releases at two locations have proved encouraging; the oriental and melon fruit flies, Dacus dorsalis (Hendel) and D. cucurbitae (Coq.) where field trials on Rota, an island in the Pacific, near Guam, proved very informative for further development, although the overflooding ratio of 10 : 1 was not reached; the Queensland fruit fly, Dacus tryoni (Frogg) where mass rearing of 10^6 pupae/week has already been achieved and field trials carried out; the olive fly, Dacus olèae (Gmelin), which is promising, interesting results being obtained in Greece, Israel and in Italy; the codling moth, Carpocapsa pomonella (L.), now being tested in the field in Canada, which proves promising. Amongst the crop pests tested in the USA are also the sugarcane borer, Diatraea saccharalis (Fab.), where difficulties are being encountered in sterilizing without affecting moth emergence; the European corn borer, Ostrinia nubilalis (Hübn.) which shows promise; the pink bollworm, Pectinophora gossypiella (Saunders), where the most suitable stages (ages) for irradiation were determined; the boll weevil, Anthonomus grandis Boheman, where preliminary sterilization data have been collected; the fall armyworm, Laphygma frugiperda (J.E. Smith), where radiation tolerance was studied; Drosophila melanogaster (Meig.), where field trials in Beltsville, Md., and other work indicate that population growth may be inhibited by a flooding ratio of 16 : 1; the Mediterranean flour moth, Anagasta (Ephestia) kühniella Zell., where mass rearing and sterilization proved feasible but ecological circumstances unfavourable.

It must be remembered that the sterile-male release method cannot always be used against an insect species despite its tremendous eradication potential for some. Various factors may be responsible for such failure. Mass production of the insect may prove too difficult or too costly; sterilization may affect insects detrimentally, in terms of life-span, development, mating behaviour, etc.; distribution of the sterile males may be unsatisfactory because of local conditions (wind, predators, etc.); serious damage may be inflicted on man, animals or plants as the result of releasing additional insects into an area; the size of the infested may be too large to be treated economically, the existing population too great for overflooding and too widely scattered for effective preliminary reduction by other means; and a lack of adequate geographical barriers may leave the area wide open to subsequent reinfestation.

The application of the technique to Mediterranean pests, such as the olive fly, the Mediterranean fruit fly, and some others appears, however, to be promising. This possibility has attracted a great deal of attention, and the Agency is supporting projects in Greece, Israel, Pakistan and Tunisia. Under a United Nations special Fund a one-million dollar project was approved recently (January 1965). The joint FAO/IAEA Division of

Atomic Energy in Agriculture will attack the Mediterranean fruit fly problem in Central America, following a request submitted by Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Panama. Present losses due to the insect are estimated at $ 7 million/year and may be expected to reach $ 82 million/year if the infestation spreads further.

The pests of grain and other stored foods (mostly Coleoptera and Lepidoptera) do not lend themselves to control measures employing the sterile-male technique (1434). There are a number of reasons for this, apart from frequent multiple-species infestation. Bulk storage would not allow efficient release and distribution of the sterile males, particularly when needed in "hot" spots. Contamination of foods to any great extent by insect debris would be inadmissible. Many Lepidoptera are sterilized only at the expense of longevity with the necessary doses (~ 50 000 rad). Disinfestation by means of ionizing radiation can, however, be approached in a different way by the bulk irradiation of stored commodities which will be discussed next.

(2) Disinfestation

Interest in the irradiation of stored commodities has caused a technology of its own to be developed, with emphasis on irradiator design and on research into biochemical and other effects of irradiation. Most of this lies outside the scope of this bibliography.

Studies dealing with infestation detection, disinfestation measures by means of specific irradiators, and economic considerations are found in part II:II-C, 1-4. Disinfestation measures rely chiefly on lethal effects, mainly at the egg stage, or on breaking the life-cycle at some stage thus preventing reproduction. The time required to affect an entire insect population will depend on the experimental conditions employed. Some of the preliminary investigations on the radiation susceptibility of different species at various developmental stages and on optimum condition for irradiation (including possibly synergistic factors) can be found in II:II-B and A. 2.

The practical economics (II:II-C. 3) of irradiation compared with conventional control measures such as fumigation of, for example, grain and grain products have been calculated for a number of irradiators; operating costs will depend on such factors as cheapness of the particular sources at that time, handling capacity, capacity exploitation throughout the year, and on depreciation (1487, 1490, 1492). The design of a production-facility has to cope with two major groups of problems. The shape and size of the particular source must be arranged to provide maximum usable radiation energy with minimum absorption in the source itself, and the conveyor system must be arranged around the source at maximum absorption of radiation without over-exposure of parts of the products and without holding up an unduly large volume of product in the facility. A large number of irradiators have been designed and tested (1492, 1487), using different shapes, sizes and types of source arrangements and conveyor systems. The majority of irradiators use a γ-source (1487-91), although a variety of sources (reviewed in 1421) have been tested, including accelerated electron sources (768, 1484). Since high voltage electron beams are limited to about 5 MeV to avoid possible induced radioactivity, this necessitates a very high handling speed for grain.

Conveyor belts prove impractical, and pneumatic or gravity-flow systems become necessary. Some (γ-)irradiators are mobile, mounted on board ship for grain treatment (1490, 1492, 1494, 1496) or on a railway car (1236), thus allowing bulk irradiation of different products at widely separated localities as and when required. The railway mobile irradiator is designed for a capacity of 10 t/h with a 10 000-rad dose, and is aimed at the disinfestation of, for example, citrus fruit. Thus grape fruit from an area where the Mexican fruit fly, Anastrepha ludens, is found could then be safely exported. The practical significance of irradiation for subsequent transportation and as a quarantine safeguard is obvious. Mobile units appear particularly suitable for seasonal products which have to be handled directly.

Since irradiation can produce 100% insect sterilization repeated fumigation and ventilation, both of which are costly, could be replaced by a single irradiation of e.g. wheat products (1490, also 1488-9, 1491). This is true provided subsequent storage is in insect-free and insect-proof containers, whether special grain silos, polyethylene-lined bags for wheat and other products, or small-scale packaging as for dried figs (1481, 1500) or spices are considered. The irradiation of packaged commodities is itself of considerable interest: with suitable packaging material (i.e. material which is insect-proof yet permeable to gases while remaining impermeable to water vapour) no reinfestation can occur and no further treatment is required.

Disinfestation of wood by irradiation [whether of termites (1501) or other wood-boring insects (1486)] presents some difficulties. According to Bletchley (1486) ~10 000 r (γ-rays) would probably be adequate for controlling wood-boring insects but an additional safety margin plus a correction factor for attenuation in the wood is necessary. Considerable work is still required before such a method could be exploited in practice.

Irradiation cannot be applied as a disinfestation measure against plant-infesting nematodes (1468) since the radioresistance of the nematodes is so high that the plant would be destroyed long before the nematodes were affected (e.g. 320 000 rad eliminate infestation by Heterodera rostochiensis).

Other areas of research in which radiation has been used are, for example, the development of strains with different nutritional requirements or of differently coloured eggs for immediate sex-differentiation, as in sericulture. In apiculture, it has been possible to control Nosema apis by irradiating the infected combs with γ-rays (1536). Strains of entomopathological fungi of increased virulence have been produced by exposure to ionizing radiations (1535, 1569, 1570).

*(3) Radiological Studies**

X-rays have proved very useful in radiological studies of a variety of ecological and physiological problems. These included investigations of crop-function, in particular crop-emptying, in Periplaneta americana (1557) and Phormia regina (1560), and a comparison of the rates at which food passes through the intestines of different species of locusts (1559). In the shipworm, Teredo sp. (1556), it was possible to study its boring habits, burrow building, preferred positions for settlement, and activity at different stages of development. Insect infestation in a number of stored commodities has been detected routinely by means of x-rays (as in, e.g., grain: 1508, 1526; wheat: 1510; dried peas: 1515; cocoa: 1514; wood: 1503-5; 1507, 1517, 1521, 1523, 1556). Seed quality, particularly of forest seed, has been assessed radiologically (1513, 1524-5); the stage of the infesting insect, the harvouring within a cocoon of a live or dead insect, possible parasitization, and traces of past infestation can be recognized.

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* It might be argued that an application of this type should not be included here, on the grounds that in all other cases we have been concerned with an effect on or change in the specimen as a result of irradiation. Here, on the other hand, the radiation is used for detecting and studying the insect, frequently in its natural habitat, without affecting the insect.

Electron microscope studies have been omitted altogether since vacuum and other working conditions involved necessitate using already fixed and, usually, stained specimens.

PART I

RADIOISOTOPES

I. INSECTS

I-A Ecology

I-A-1 GENERAL ARTICLES. SURVEYS

1* Андреев, С.В. ИЗУЧЕНИЕ И РАЗРАБОТКА МЕТОДОВ БОРЬБЫ С ВРЕДИТЕЛЯМИ И БОЛЕЗНЯМИ РАСТЕНИЙ С ПОМОЩЬЮ РАДИОАКТИВНЫХ ИЗОТОПОВ И ИЗЛУЧЕНИЙ. Стр. 621-? в сб. "Всесоюзное совещание работников сельскохозяйственной науки". М. 1957.

Andreev, S.V. STUDY AND FORMULATION OF METHODS OF CONTROLLING PLANT PESTS AND DISEASES BY MEANS OF RADIOISOTOPES AND RADIATION. p.621-? in "Proceedings of the All-Union Conference of Workers in Agricultural Science, Moscow, 1957".

2 Auerbach, S.I. RADIATION ECOLOGY. p.47-72 in "Health Physics Division. Annual Progress Report for Period Ending 31 July 1962". ORNL-3347, Oak Ridge National Lab., Tenn. 12 Nov. 1962.

Samples taken in 1961 from White Oak Lake bed showed that concentrations of radionuclides in herbivorous insects were essentially unchanged since 1958, for both Sr^{90} and Cs^{137}. Results are presented of tracer studies on insects and arthropods (including the millipede, *Dixidesmus erasus* with Co^{60}, Sr^{85}, Cs^{134}, Fe^{59} and Zn^{65}). Studies were continued on the aquatic ecology of the Clinch River and the fate and effects of radionuclides released in waste solutions. The mean chromosomal aberration per individual per month of larvae of *Chironomus tentans* exposed to radiation 20-1000 times above the background intensity was computed for testing for a change in frequency of chromosomal polymorphism. An analysis of variance among these monthly means showed no significant difference among them.

3 Auerbach, S.I., Schultz, V. ONSITE ECOLOGICAL RESEARCH OF THE DIVISION OF BIOLOGY AND MEDICINE AT THE OAK RIDGE NATIONAL LABORATORY. TID-16890, Oak Ridge National Lab., Tenn. and Division of Biology and Medicine, AEC. Oct. 1962. 146p.

The programme is described for the period 1955-63, with details of investigators, techniques, aims and results where available (including lists of reports and outside publications). The following investigations cited are relevant to this bibliography: - investigations on sterility and deformities of *Onthophagus* (Coleoptera, Scarabaeidae) induced by γ-radiation (1955); differential effects of γ-radiation on predator and prey species of mites (1955-6); effects of γ-radiation on Collembola population growth (1956-7); effects of acute and fractionated doses of γ-radiation on *Trogoderma* (Coleoptera, Dermestidae) (1956-7); arthropods associated with litter breakdown on decimeter litter bags (1959-60); gross effects of soil arthropods on leaf litter breakdown and release of radionuclides (1961-2) [4 levels of naphthalene at 100, 35, 10 and 0 g/m², 5 litter bags containing oak leaves tagged with Cs^{137} per plot, bags to be checked periodically for radioactivity, arthropods, respiration and microfloral counts]; insect invaders of pioneer vegetation on White Oak Lake bed (1956-8); gross aspects of movement of fission products in the soil-to-plant-to-insect food chain (1958-9); Sr^{90} and Cs^{137} accumulation in plant-insect-bird food chain (1958-9); accumulation and elimination of Cs^{137} by a grasshopper, *Romalea microptera* (1957); accumulation of Sr^{90} and Cs^{137} by grasshopper species on White Oak Lake bed (1959-60); turnover of Cs^{137} by *Chrysomela knabi* (1960); the effect of effluent atomic wastes on a *Chironomus tentans* Fabricius population as determined by salivary gland chromosome analysis (1960-3).

(See also 108 - 11, and 123 - 4).

4 Jenkins, D.W. RADIOISOTOPES IN ECOLOGICAL AND BIOLOGICAL STUDIES OF AGRICULTURAL INSECTS. p.3-20 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Very comprehensive review article with 118 references. The varied uses to which radioisotopes have been and can be put in basic biological and ecological studies of insects of agricultural and veterinary importance are summarized. New possibilities of insect control are discussed. Three tables are included, amongst them a listing of radioisotopes utilized so far.

5 Jenkins, D.W. USE OF RADIONUCLIDES IN ECOLOGICAL STUDIES OF INSECTS. p.431-40 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.

Review article, divided into sections dealing with the selection of radionuclides and methods of labelling; forest and orchard insects; crop insects; social insects; insects affecting man and animals; parasites and predators; insect transmission of disease; and population studies. 108 references are cited (up to 1961).

6 Kansu, A. BÖCEK BIYOLOJI VE ÖKOLOJISINE AIT ARASTIRMALARDA RADYOIZOTOPLARDAN ISTIFADE. (The use of radioisotopes for research in insect ecology and biology). Bitki Koruma Bült. 2, 7 (1961) 24-45. (In Turkish, with English summary).

Review article, with 65 references.

See also:

1575 Radyoizotoplarin entomoloji alaninda kullanilmasi. (Use of radioisotopes in entomology). (Kansu, 1963).

I-A-2 BEHAVIOUR

I-A-2-a FEEDING

General

7 Dadd, R.H. FEEDING BEHAVIOR AND NUTRITION IN GRASSHOPPERS AND LOCUSTS. p.47-109 in "Advances in Insect Physiology. Vol.I". Beament, J.W.L., Treherne, J.E., Wigglesworth, V.B., Eds. New York, Academic Press. 1963.

Review article, divided into sections on feed and feeding (food-plant preferences, feeding behaviour, theories of food-plant selection), and nutrition (general considerations, specific requirements, and idiosyncracies of locust nutrition). Radioisotopes have been used in a number of studies but are not mentioned specifically. A total of about 180 references is cited.

8 Gösswald, K., Kloft, W. EINBLICKE IN DAS STAATENLEBEN VON INSEKTEN AUF GRUND RADIOBIOLOGISCHER STUDIEN (Aspects of life in an insect colony, based on radiobiological studies). Imkerfreund 16, 1 (1961) 7-12. (In German).

Review article. Radioisotope techniques have been applied in studies of food distribution amongst ants, bees and termites, dealing with such aspects as the relative and actual speed, method, and the quantity of food distributed, and its dependence on such factors as temperature and humidity. The quality of food has also been investigated and found to vary, i.e. queen bees are given more complex food incorporated in gland secretions, and not merely regurgitated food. New light is also thrown on the roles played by sexually potent and other castes in the social structure of the different insects. (No references are given).

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9 Gösswald, K. ON THE METHODS OF CONTROLLING MATERIALS FOR TERMITE RESISTANCE WITH PARTICULAR CONSIDERATION OF BIOLOGICAL DATA UNDERLYING THE TECHNIQUE OF CONTROL. p.169-78 in "International Symposium on Termites in the Humid Tropics, New Dehli, 4-12 October 1960". Paris, UNESCO. 1962.

After discussion of the necessity and feasibility of laboratory tests, test techniques are reviewed. Suitable standard termites are required. Most of the work considered was done on the dry-wood termite, Kalotermes flavicollis Fabricius, being in the author's opinion, the most suitable test insect; materials resistant to Kalotermes are generally so to wet-wood termites (Reticulitermes lucifugus Rossi) and others. Data on temperature and humidity, other physiological conditions of the test room, test periods, and different tests are discussed. Some radioisotope (P^{32}) work is described on the stages which actually take in food and on the quantity consumed, and details of the technique are given.

10 Abdel-Malek, A.A., Baldwin, W.F. SPECIFICITY OF PLANT FEEDING MOSQUITOES AS DETERMINED BY RADIOACTIVE PHOSPHORUS. Nature, Lond. 192, 4798 (1961) 178-9.

Flowers and leaves of 24 different species of native plants were labelled with P^{32} solutions (20 μc/ml). Preliminary tests with cotton wicks using different concentrations of P^{32} (as $H_3P^{32}O_4$ in 5% dextrose solution) had proved that this concentration, on feeding, gave easily detectable counts in both male and female mosquitoes. The technique of labelling is described. Larvae of native mosquitoes (Aëdes impacabilis (Walker), A. dianteus H.D. and K., and A. punctor (Kby.)) were collected from temporary pools and swamps, and reared to the adult stage in the laboratory. Laboratory tests showed that feeding had taken place on only 3 species: Viola conspersa, Trillium graniflorum, and Spiraea latifolia. Under the conditions of the experiments, mosquito feeding was confined to plant sap from the leaves.

11 Auclair, J.L. APHID FEEDING AND NUTRITION. Annu. Rev. Ent. 8 (1963) 439-90.

Comprehensive review article, including numerous studies in which radioisotopes had been utilized. Different aspects of feeding are considered on p.439-54. Very little is known about the nutritional requirements of aphids; a technique (used elsewhere) which could easily be applied to determine essentiality of amino acids in aphids makes use of injection into the haemolymph of glucose-U-C^{14} or L-glutamic acid-U-C^{14}, followed by a determination of the radioactivity of each amino acid subsequently isolated from the insect. Further sections deal with enzymes of the alimentary tract; honeydew (p.459-71); and symbiotes (with special reference to the nitrogen economy of aphids).

12 Banks, C.J. SOME RECENT STUDIES, INVOLVING THE USE OF RADIOISOTOPES, OF THE FEEDING BEHAVIOUR OF TWO PHYTOPHAGOUS INSECTS. p.175-7 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Three examples of researches made on insect pests with radioisotopes are given. The feeding and excretion rates of Aphis fabae Scop. were estimated by allowing the insects to feed on bean leaves made radioactive with P^{32}, and then relating the radioactivity of the aphids to that of the leaves. The results are presented and the method critized. By allowing groups of A. fabae to feed on bean plants made radioactive with P^{32}, the hypothesis that ant-attendance significantly increases the aphid's feeding and excretion rates was confirmed. The movements and feeding behaviour in the field of adult Senn bugs (Eurygaster integriceps, Put.) were studied in Iran by tagging individual insects with small pieces of Ta^{182} so that they could be detected from a distance with a suitable instrument. The results are described. (Auth)

13 Banks, C.J., Dezfulian, A., Brown, E.S. FIELD STUDIES OF THE DAILY ACTIVITY AND FEEDING BEHAVIOUR OF SUNN PEST, Eurygaster integriceps Put., (Hemiptera, Scutelleridae) ON WHEAT IN NORTH IRAN. Ent. exp. appl. 4 (1961) 289-300.

The horizontal and vertical movements and the daily feeding activity of 6 young adult Sunn Pest (or "Senn"), each tagged with a small piece of Ta^{182} so that it could be located, were studied in wheat fields in north Iran for 3-4 d at the start and at the end of the adults' feeding period in June 1960. Insects could be detected in the wheat or in the soil at from ~40 cm with a portable G-M-probe. Microclimatic records (temperature and humidity) were maintained, and the methods and labelling described. Labels were cut from an irradiated strip of Ta^{182}, ca. 0.05 mm x 0.16 mm x 0.46 mm, av. weight 0.06 mg, av. specific activity 8 μc (120 μc/mg). An adult bug (young) is ~12 mm long and 7 mm wide, av. weight 11 mg. Observations indicate a change in behaviour pattern prior to migration, presumably associated with accumulating food reserves.

14 Crossley, D.A., Jr. CONSUMPTION OF VEGETATION BY INSECTS. p.427-30 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.

Radioactive tracers were used to estimate the consumption of vegetation by populations of insects. Such estimates were made for insects on the contaminated White Oak Lake bed, Oak Ridge, Tennessee, where insect populations contained Cs^{137} and Sr^{90} concentrations which were in equilibrium with concentrations in the plants. The rate of feeding was estimated from the whole body burden of Cs^{137}, the biomass, and an average elimination rate for the insects, plus Sr^{90} concentrations and biomass of the host plants. The calculations indicate that approximately 6% of the plant biomass was consumed by insects during a growing season. The insects considered were grasshoppers (Romalea micropters, Melanoplus differentialis, M. femur-rubrum) and the willow chrysomelid Chrysomela knabi.

15 Cavalloro, R. STUDIES ON THE NUTRITION OF Myzus persicae USING P^{32}. Tobacco, Rome 65 (1961) 287-97.

Nicotiana tabacum var. Samsun infested with M. persicae were labelled by placing the roots in a mineral solution containing neutralized $H_3P^{32}O_4$ (2 mc/ml) for 4 h. Leaves and insects were then separated, frozen, and homogenized. After lyophylization, the extracts were separated by paper electrophoresis and the radioactive bands located by autoradiography and counted. 4 bands were detected: phospholipids and inorganic phosphate, nucleotides, sugar phosphates, and additional inorganic phosphates. The percent distribution of the radioactivity in each band for the leaf extracts was 9.3, 0.8, 8.5 and 81.4, respectively. For the insect extracts, it was 7.9, 5.1, 10.9, and 76.0, respectively. (CA 56: 1962, 9244i).

16 Ehrhardt, P. ON THE PROBLEM OF FOOD PLANT SELECTION BY APHIDS. Experientia 19, 4 (1963) 204-5. (In German, with English summary).

Megoura viciae pierces the sieve tubes of non-host plants, Allium schoenoprasum and Poa pratensis, but does not take up P^{32} from the parenchyma. Aphids apparently effect a probe before settling on the sieve tubes of the plant.

17* Fleming, F. PENETRATION AND DESTRUCTION OF PLANT TISSUES DURING FEEDING BY Lygus lineolaris. p.1003-7 in "Report of the XIVth International Horticultural Congress, Netherlands 1955". Wageningen, H. Veenman and Zonen.

In an attempt to determine the cause of the notoriously poor germination of seeds of the Umbelliferae, it was found that an insect (Lygus) destroyed the embryo without disturbing the other parts of the seed. In the section dealing with the mechanics of the damage caused by Lygus, (p.1005), reference is made to results obtained earlier with P^{32}, Ag^{110} and Ce^{144}.

18* Flemion, F. PENETRATION AND DESTRUCTION OF PLANT TISSUES DURING FEEDING BY Lygus lineolaris P. de B. Proc. 10th Int. Congr. Ent. 3 (1958) 475-8.

It has not yet been determined whether the lesions produced by the tarnished plant bug, L. lineolaris, are produced solely by the mechanics of piercing and sucking or whether in addition the saliva deposited during feeding produces secondary infections and/or is phytotoxic. The amounts of fluid imbibed and the quantity of oral secretions deposited in the host tissue were determined by the use of radioisotopes. Estimates of 0.05-0.25 µl were obtained by means of P^{32} for the quantity of secretion deposited, estimates of 0.2-2.0 µl (by means of Ag^{109} and Ce^{144}) for the amount of fluid imbibed. Techniques are described for detecting and assessing the damage done to the host.

19 Flemion, F. INSECT DAMAGE AS A FACTOR AFFECTING FRUIT SET. p.163-71 in "Proceedings of Campbell Soup Company - Plant Science Symposium, 1962".

Studies (Fleming et al.) of internal damage caused, as well as of the feeding mechanisms involved in the common and extremely destructive tarnished plant bug, Lygus lineolaris (P. de B.) [L. oblineatus (Say)], are reviewed. Reference is made to earlier (pre-1961) work in which P^{32} was used for estimating the quantity of secretion and Ag^{110} and Ce^{144} for the amount of fluid imbibed during feeding (p.167).

20 Gallun, R.L., Langston, R. HESSIAN FLY FEEDING STUDIES UTILIZING RADIOISOTOPE P-32. Proc. N. Cent. Br. ent. Soc. Amer. 17 (1962) 32.

(See 21)

21 Gallun, R.L., Langston, R. FEEDING HABITS OF HESSIAN FLY LARVAE ON P^{32}-LABELED RESISTANT AND SUSCEPTIBLE WHEAT SEEDLINGS. J. econ. Ent. 56, 5 (1963) 702-6.

At Purdue University during 1960 and 1961, experiments in which P^{32}-labelled potassium dihydrogen phosphate was utilized, showed that: (1) Hessian fly larvae (Phytophaga destructor (Say)) fed on both P^{32}-treated and untreated resistant wheat Purdue 4217A3-1-6-3 for not more than 2 d and on the treated susceptibe wheat Michigan Amber for at least 15 d; (2) maximum growth and radiation was detected from 5-d-old larvae dissected from treated susceptible wheat plants; (3) treated resistant wheat plants, at an age when Hessian fly larvae began to feed in previous experiments, had more detectable P^{32} than treated susceptible wheat plants of a similar age; (4) the growth of Hessian fly larvae, when subjected at 4 d of age to β-radiation at the rate of 10 mc/10 ml, was adversely affected, whereas the growth of larvae subjected at 5 to 14 d was not. (Auth.)

21 a Henning, E. NEUERE UNTERSUCHUNGEN ÜBER DIE BEDEUTUNG DER SOGENANNTEN PROBESAUGSTICHE BEI APHIDEN. (Recent investigations on the importance of the so-called probing punctures by aphids). Z. Pfl.Krankh. 69, 6 (1962) 321-30. (In German, with English summary).

In investigations on the shallow punctures caused by the probing of Aphis fabae Scop. on the leaves and stems of plants, as distinct from the deep punctures that follow prolonged resting of the aphid in one position, no taking up of any substance from plants of broad bean (Vicia faba) could be demonstrated by either histological or P^{32} tracer methods. The aphids appeared to feed from the phloem, and penetration of the stylets to this depth took an average of 45-60 min. The probing seemed to be merely a mechanical testing of the surface for a suitable site for penetration. (From auth. summary)

22 Каменкова, К.В., Молчанова, В.А. УСТАНОВЛЕНИЕ ФАКТОВ ДОПОЛНИТЕЛЬНОГО ПИТАНИЯ НАСЕКОМЫХ С ПОМОЩЬЮ РАДИОАКТИВНОГО ФОСФОРА И ЕГО ВЛИЯНИЕ НА СОЗРЕВАНИЕ ЯИЦ МЕНИСКУСА, ПАРАЗИТА ЗЕРНОВОЙ СОВКИ. Стр. 29-30 в сб. "Материалы Симпозиума по применению биофизики в области защиты растений". Л. 1961. Р. Ж. Биол. № 18Ж374. 1962.

Kamenkova, K.V., Molchanova, V.A. DETERMINATION OF FACTS ON SUPPLEMENTARY FEEDING OF INSECTS WITH THE AID OF RADIOACTIVE PHOSPHORUS AND ITS EFFECT ON THE MATURING OF EGGS OF Meniscus agnatus, A PARASITE OF Hadena basilinea Sch. p.29-30 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961. R.Zh. Biol. No. 18Zh374. 1962.

The study concerned feeding of M. agnatus, a parasite of H. basilinea, and the development of its germ cells, using food plants tagged with P^{32} by placing them in a P^{32}-solution (10 µc/H_2O). Flowering Onobrychis, Phacelia, Euphorbia, Peuceudanum oreoselinum and Sisymbrium were used in the experiments. Parasites in the control group were fed on nectar of the named species of plants and a sugar solution. The number of mature eggs increased to 306 (94%) when feeding on nectar from radioactive Onobrychis; the corresponding figures for Sisymbrium nectar were 38 (24%), for Phacelia to 36 (22.8%) and for Euphorbia to 11 (7%). Span of life of M. agnatus was curtailed on the average by 20 d when feeding on a 20% sugar solution (with isotope), while the number of mature eggs in the female proved to be lower. Same results were obtained by feeding M. agnatus on nectar of P. oreoselinum, whose stems rapidly absorb the aqueous isotope solution.

23 Kloft, W., Ehrhardt, P. STUDIES ON THE ASSIMILATION AND EXCRETION OF LABELLED PHOSPHATE IN APHIDS. p.181-89 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Measurements show that aphids take up food only some time after stinging, at a moment which corresponds with reaching the phloem. The activity then suddenly increases to an approximate maximum, which is reached after the intestinal tract has become full of labelled phloem sap. Subsequently, however, the activity increases slowly because of resorption from the midgut. In the meantime, incorporation (assimilation) and excretion of radioactive material begins in different ways. The interval between the uptake of the tracer from a plant to its re-excretion with the saliva is 5 h at 22-24°C. This period, as well as the exact course of excretion of saliva during sucking and the distribution of saliva in the plant itself, were analyzed in detail. Tracer experiments indicate how the problem of virus transmission (especially of persistent ones) by plant-sucking insects may be attacked. Further excretion of the radioisotope takes place in the honeydew as well as through the bearing of larvae. On hatching, these larvae have only a low activity but this increases after longer periods of resorption in the material organism. On account of continuing ovoviviparie and by the use of P^{32} it was possible to obtain a record of the phosphate metabolism of the ovary in the live aphid. By measuring the different kinds of excretion as well as the remaining activity, the biological half-life and the amount of tracer actually assimilated may be determined. Any circulating radioactivity may be detected by measuring the haemolymph. Constant temperature must be ensured since the processes are highly sensitive to changes in temperature. (From auth.)

24 Marek, J. DIE WIRKUNG VON APHIDENSTICHEN AUF PFLANZLICHE ZELLEN. (Effects on plant cells of aphid punctures). Ent. exp. appl. 4 (1961) 20-34. (In German)

Aphids, Myzus ascalonicus Donc., were allowed to prick detached bulb scales of Allium cepa, in green light, and subsequently anaestetized with CO_2. The stylets were then severed, and the epidermis dissected off and examined under a phase microscope. Intercellular and extracellular puncturing could be distinguished. In cells which had been pierced directly a saliva sheath was formed. The limits of saliva action were studied with P^{32}-labelled aphids. After they had pierced the epidermis the part containing the stylets was mounted on a slide, and the preparation kept in the dark for 14 d, with a special film (Kodak, autoradiographic) covering it. After developing and fixing, darkened spots indicated cell portions which had been rendered radioactive by the saliva. Mechanical stimulus by needles only a few μ in diameter caused streaming in the cell plasma and a shortening of deplasmolysis time. The importance of these mechanical effects must clearly not be underestimated. Increased plasma streaming was apparently caused by amino acids in the saliva and by the amino acids derived from proteins on cell injury. Piercing with fine glass capillaries containing amino acids also cut down deplasmolysis time.

25 Marek, J. ÜBER DAS EINSTICH- UND SAUGVERHALTEN DER ZWIEBELLAUS, Myzus ascalonicus Doncaster. (Study on the piercing and sucking behaviour of the aphid Myzus ascalonicus Doncaster). Z. Pfl.Krankh. 68 (1961) 155-65. (In German, with English summary).

Aphids were rendered radioactive via P^{32}-labelled host plants. The techniques used subsequently are described in detail. Aphids which had been sucking for some time showed a greater tendency to pierce fresh plants than starved insects. By means of green light M. ascalonicus could be induced to pierce such unfamiliar material as filter paper. The aphids deposit saliva in all tissues if penetrated even for only a short time. This was demonstrated by G-M-counters and autoradiography. M. ascalonicus is able to distinguish different degrees of concentration in solutions of an acid, bitter or salty character. Sweet-tasting liquids were absorbed, no matter how highly concentrated. Buffer solutions of pH 6.2 - 8.4 represent the preferred pH range.

26 Новокрещенова, Н.С., Солдаткин, И.С., Левошина, А.И. СРАВНИТЕЛЬНАЯ ЧАСТОТА ПИТАНИЯ РАЗЛИЧНЫХ ВИДОВ БЛОХ, ОПРЕДЕЛЕННАЯ В ЛАБОРАТОРНЫХ УСЛОВИЯХ С ПРИМЕНЕНИЕМ МЕТОДИКИ РАДИОАКТИВНЫХ ИНДИКАТОРОВ. Вопр. Экол., Киев 4 (1962) 135-6.

Novokreshchenova, N.S., Soldatkin, I.S., Levoshina, A.I. THE COMPARATIVE FREQUENCY OF FEEDING OF VARIOUS KINDS OF FLEA, AS DETERMINED UNDER LABORATORY CONDITIONS, USING THE RADIO-TRACER METHOD. p.135-6 in "Voprosy ekologii, Vol.4, Kiev, 1962".

27 Oak Ridge National Lab., Tenn. STUDIES ON Chrysomela knabi. p.91-5 in "Health Physics Division, Annual Progress Report for period ending July 31, 1961". ORNL-3189.

Laboratory measurements were made on feeding and elimination rates for both larvae and adults. The investigation was aimed at testing the precision of $ra = \lambda Q_e$ where

r = rate of ingestion of a given radionuclide,
a = proportion absorbed from the intestines
λ = ratio of ln 0.5 to the biological half-life T_b (or the effective half-life if the physical half-life is short) for the given radionuclide
Q_e = body concentration at equilibrium of that nuclide in the insects.

Work is proceeding along the lines of (1) comparison of the rate of feeding, r, as calculated and as measured in laboratory experiments for a single insect species (Chrysomela knabi), and (2) investigation of rate of elimination of radioisotopes as a function of size of insect. The consumption and elimination of Cs^{134} is discussed.

28 Orenski, S.W., Maramorosch, K. THE FEEDING OF NORMAL AND ASTER YELLOWS-INOCULATED CORN LEAFHOPPERS. Phytopathology 52 (1962) 1219.

The earlier finding, that the corn leafhopper (Dalbulus maidis) can extend its host range after acquisition of aster yellows virus, has been studied further. Normal and viruliferous corn leafhoppers, fed on plant juices and sugar solutions through semipermeable animal membranes, experienced high mortality. None of the leafhoppers survived more than 7 d, whether food or distilled water was supplied through the membranes. Anal feeding also was attempted, but discontinued because of poor survival. Normal corn leafhoppers fed no better on aster leaves from which the epidermis was stripped, than on normal leaves. Feeding on isotope-labelled leaves, using aster leafhoppers Macrosteles fascifrons as controls, showed that normal and viruliferous corn leafhoppers fed equally well on corn leaves and acquired as much isotope as did aster leafhoppers. On the other hand, corn leafhoppers acquired only 1-10% as much isotope from aster leaves as aster leafhoppers did. Although viruliferous corn leafhoppers fed slightly better on aster leaves than normal ones, this difference was found only with corn leafhoppers confined to young aster leaves. (Auth.)

29 Orenski, S.W., Staples, R.C., Maramorosch, K. THE UPTAKE OF C^{14} AND P^{32} FROM LABELED LEAVES BY TWO SPECIES OF LEAFHOPPER VECTORS. Phytopathology 52 (1962) 1220.

A study was made of food uptake by Dalbulus maidis Delong & Wole and Macrosteles fascifrons (Stål) on detached leaves of Zea mays and Callistephus chinensis labelled with C^{14} or P^{32}. Measurements of isotope uptake and distribution throughout a leaf showed a general decrease in radioactivity from the base toward the tip. Large variations were encountered between corresponding samples cut from opposite sides of a given leaf. A clearly defined linear correlation was found between the isotope content of a leaf and isotope uptake by feeding leafhoppers. There was no significant difference between isotope uptake by males and females, although wide variations were found between individual insects feeding for 24 h or longer. During short feeding periods, insects acquired only small amounts of isotope and up to 50% of radioactivity accumulated in their heads. The distribution of radioactivity changed with increased isotope uptake and after 24 h only about 10% of the total isotope was concentrated in the heads. When D. maidis were placed on upper and lower surfaces of a corn leaf, those on lower surfaces acquired more isotope. (Auth.)

30 Quraishi, M.S. WATER AND FOOD RELATIONSHIP OF THE EGGS AND FIRST INSTAR NYMPH OF Eurygaster integriceps WITH THE AID OF P^{32}. J. econ. Ent. 56, 5 (1963) 666-8.

The eggs and 1st instar nymphs of E. integriceps Put. were studied. The eggs can withstand extreme dry conditions and can develop in a desiccator of $CaCl_2$. Three series of experiments were conducted in order to discover whether food is essential for its growth and moulting. In one series of experiments, freshly-emerged nymphs were maintained for 48 h on P^{32}-labelled wheat plants. Their changes in weight and radioactivity were recorded. In another series, nymphs were kept in a Petri dish with small filter paper disks soaked in P^{32}-solution. Weight and radioactivity were again checked after 48 h. It could be demonstrated that in order to moult, the nymph must feed, though the food may consist only of water absorbed through a filter paper. The length of life of a starving nymph shows positive correlation with humidity.

31 Shapiro, I.D., Khotyanovich, A.V., Vedeneeva, N.A. PHYSIOLOGICAL EFFECT OF FRIT-FLY (Oscinosoma frit L.) ON EMBRYONIC TISSUES OF MAIZE. Dokl. Akad. Nauk SSSR 140 (1961) 978-80. (In Russian). English Translation: Proc. Acad. Sci. USSR. biol. Sci. Sect. 140 (1962) 886-8.

The pattern of lysis of young maize tissues (by excreta) was investigated. The authors found that the excretory products of the larvae contain proteolytic enzymes, and enzymes of the amylase and invertase type which do not play any part in lysis. The results of some experiments with C^{14}-labelled glucose (glucose-1-C^{14}) indicated that frit-fly larvae utilize simple sugars. Maize shoots (at 3-4 leaf stage) were labelled by immersion in a glucose solution (specific activity 5 μc/ml) for 48 h at 25-27°C. The plant stems (without leaves) were put into wide tubes containing larvae. After 48 h the larvae were removed, washed thoroughly, and homogenized. The radioactivity of the homogenate was then assayed. The average specific activity of such larvae was 89 cpm for a specific activity of 2210 cpm in the plant.

32 Шапиро, В.А., Хотянович, А.В. К ВОПРОСУ О ВОЗРАСТНЫХ ОСОБЕННОСТЯХ ПИТАНИЯ ЛИЧИНОК Apanteles glomeratus L. Стр. 67-9 в сб. "Материалы Симпозиума по применению биофизики в области защиты растений". Л. 1961. Р. Ж. Биол. №18Ж355. 1962.

Shapiro, V.A., Khotyanovich, A.V. AGE CHARACTERISTICS INVOLVED IN THE FEEDING OF Apanteles glomeratus L. LARVAE. p.67-9 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961. R. Zh. Biol. No. 18Zh355. 1962.

Caterpillars of Pieris brassicae infested by the parasite A. glomeratus were fed on cabbage leaves infiltrated by a P^{32}-radioactive solution of KH_2PO_4 with a specific activity of 0.95 μc/ml. The caterpillars and the parasites were desiccated after the feeding and their radioactivity was determined per 100 mg of dry weight. Radioactivity of the haemolymph was computed separately. It was established that the P^{32} penetrated into the host as well as the parasite. The haemolymph showed highest radioactivity in the host. In the parasite, the radioactivity varies in the development process. It is highest in the penultimate larval stage (51.4%) and decreases through the last stage and pupas to 15%. This is explained in terms of the varying feeding regimen of parasite larvae at different stages. Young larvae, up to the penultimate stage, feed on haemolymph and, in consequence, intensively accumulate the P^{32}. Larvae of the last stage discontinue feeding on haemolymph and change to feeding on the host's fat, hence the quantity of the isotope decreases in them. (BA 43: 1963, 12513)

33 Солдаткин, И.С., Новокрещенова, Н.С., Руденчик, Ю.В., Островский, И.Б., Левошина, А.И. ОПЫТ ИЗУЧЕНИЯ АКТИВНОСТИ ПИТАНИЯ БЛОХ БОЛЬШИХ ПЕСЧАНОК В ПРИРОДНЫХ УСЛОВИЯХ С ПРИМЕНЕНИЕМ РАДИОАКТИВНЫХ ИНДИКАТОРОВ. Зоол. Ж. 40, 11 (1961) 1647-50. Р.Ж. Биол. №12К139. 1962.

Soldatkin, I.S., Novokreshchenova, N.S., Rudenchik, Yu.V., Ostrovskiĭ, I.B., Levoshina, A.I. EXPERIMENTS ON STUDYING THE FEEDING ACTIVITY OF FLEAS PARASITIZING GERBILLINAE UNDER NATURAL CONDITIONS BY MEANS OF RADIOISOTOPES. Zool.Zh. 40, 11 (1961) 1647-50. R. Zh. Biol. No.12K139. 1962.

In May and October of 1959 and April, May and Oct. of 1960, in colonies of Rhombomys opimus in the in the northwestern Kyzylkum, all the animals were captured, given glycine or acetic acid containing C^{14} in a dose of 200 μc intragastrically, and then released. After varying periods of time the colony was excavated and among the fleas (Xenopsylla gerbilli caspica Ioffe) collected the percentage having ingested the radioactive label was determined by autoradiography. A marked seasonal difference in feeding habits was apparent in the spring and autumn. Other ecologico-physiological indices were also found to vary, such as the level of reproduction, the number of fleas gorged with blood (Ioffe's alimentary index), and the ratio of fleas simultaneously feeding on a rodent to the total number of fleas. Thus, in the spring, 75-85% of Xenopsylla gerbilli caspica had ingested the blood of a gerbil by 0.5-3 d, 42-46% were found on a gerbil at any one time, and 74-83% of the females were engaged in reproduction. In the fall, after 5-15 d, 25-40% had ingested the blood, 7-10% were found on the gerbils, and only 0.8-1.3% of these females were ready to lay eggs. In the fall the greater part of the flea population was in the young imago stage, with large fat-bodies, distinguished by their resistance to the effect of unfavorable conditions. Some of the labeled fleas admitted to the burrow in Oct. were recovered in April, but the fleas penetrating the burrow in May could not be found in Sept. The seasonal variations in feeding habits must be taken into account in experiments to eradicate fleas by systemic poisons. It is suggested that spring epizootia of plague may be due to intensified feeding activity of fleas at that time, whereas atumn fleas may assure preservation of the plague microbe for long periods, by virtue of their ecological indices.

See also:

35 Sur la transmission d'isotopes radio-actifs entre deux fourmilières d'espèces différentes (Formica rufa et Formica polyctena). (Chauvin et al., 1961)
49 Radiobiological study on the social feeding organization of the honey ant, Proformica nasuta (Nyl). (Stumper, 1961)
53 Use of isotopes for investigating the behaviour and ecology of insect pests in some recent studies. (Quraishi, 1963)
125 Experimental isolation of food chains in an old-field ecosystem with the use of phosphorus-32. (Odum and Kuenzler, 1963)
135 Assimilation de la cellulose et microorganismes intestinaux chez Gryllus bimaculatus De Geer Insecte, Orthoptère, Grylloidea). (Martoja, 1962)
136 Some predators and scavengers feeding upon pink bollworm moths. (Clark and Glick, 1961)
140 Application of radioactive isotopes to the study of some problems of flea ecology. II. The contact between rodents and the degree to which ectoparasites are interchanged in a population of Rhombomys opimus. (Sviridov, 1963)
141 Use of radioactive isotopes for the study of certain problems of flea ecology. I. Alimentary relations of fleas of the Xenopsylla with Rhombomys opimus Pall. under natural conditions. (Sviridov et al., 1963)
143 Use of radioactive tracers in the study of insect-plant relationships. (Crossley, 1963)
144 Note préliminaire sur l'utilisation des radioisotopes dans l'étude des parasites du contonnier en Afrique. (Delattre, 1963)
158 Determination by radioactive iron (Fe^{59}) of the amount of blood ingested by insects. (De Freitas and Da Silveira Guedes, 1961)
166 The problem of the excretion of radioactive isotopes by various aquatic invertebrates. (Getsova, 1961)
225 Rate of equilibration of the contents of the gut of Anopheles quadrimaculatus larvae with the surrounding medium. (Friedman, 1963)
489 Studies on the character and prevention of the virus disease of garden crops. II. Studies on the mechanism of aphid transmission of mosaic disease of Japanese radish, using radioactive phosphorus. (Nishi, 1959)
486 Ecological and therapeutical studies on the virus diseases of garden crops - Studies on the transmission of plant viruses by aphids. (Japan. Kyushu Agricultural Experiment Station, 1963)

487 Acquisition and transmission of aster yellows virus. (Maramorosch, 1962)
490 Studies on the varietal resistance of garden crops to the virus disease. V. On the course of aphid transmission of the mosaic disease of Japanese radish determined by P^{32} or S^{35} (1). (Nishizawa et al., 1958)
491 Studies on the mechanism of aphid transmission of mosaic disease of Japanese radish using radioactive phosphorus 32. (Nishizawa et al., 1959)
1570 Use of radioisotopes and radiation in the control of plant and animal insect pests. (Andreev, et al., 1963)

I-A-2-b TRANSMISSION OF FOOD

34 Alibert, J. ÉCHANGES TROPHALLACTIQUES CHEZ UN TERMITE SUPÉRIEUR. CONTAMINATION PAR LE PHOSPHORE RADIOACTIF DE LA POPULATION D'UN NID DE Cubitermes fungifaber. Insects sociaux 10, 1 (1963) 1-12. (In French, with English summary).

Des nids de C. fungifaber sont mis en élevage sur de l'humus contaminé (^{32}P). La radioactivité des insectes, mesurée après un temps de contact variable, permet de séparer deux catégories d'échanges trophallactiques: les échanges d'aliment régurgité, décelables dès les premières expériences, et les échanges de liquide salivaire apparaissant plus tardivement, 25 à 30 h après la mise en contact du nid avec l'humus marqué. On n'observe pas de différence significative dans la répartition du ^{32}P selon la zone de prélèvement des échantillons de population, sauf chez des soldats des nids isolés un temps court sur l'humus. La contamination des ouvriers est très rapide et la distribution du P dans cette caste, hétérogène. Certains ouvriers ne se nourrissent pas directement d'humus pendant le temps de l'expérience; ils reçoivent, ainsi que les soldats, de l'aliment régurgité (stomodéal). La reine est la première contaminée par le liquide salivaire des ouvriers, et sa radioactivité prouve une absorption constante de nourriture. Les ailés proches du vol nuptial sont gavés de salive, ainsi que les soldats blancs. Le couvain, les nymphes de l'avant-dernier stade et le roi ne reçoivent qu'une faible quantité de salive; le roi a un rythme d'alimentation lent et peu de besoins; les nymphes ont, sans doute, recours à un autre mode d'alimentation pendant l'avant-dernier stade.

35 Chauvin, R., Courtois, G., Lecomte, J. SUR LA TRANSMISSION D'ISOTOPES RADIOACTIFS ENTRE DEUX FOURMILIÈRES D'ESPÈCES DIFFÉRENTES (Formica rufa et Formica polyctena). Insectes sociaux 8, 2 (1961) 99-107.

Pour le marquage, 50 mc d'une solution colloïdale standard du CEA d' ^{198}Au mélangés à 50 cm d'une solution sucrée très épaisse, ont été versés sur la surface de la fourmilière. Les F. polyctena qui ont reçu un radioisotope l'ingèrent rapidement et peuvent le transmettre aux fourmilières voisines de F. rufa. La radioactivité se localise dans l'abdomen des fourmis. Il est probable qu'il s'agit d'un échange par voie buccale. Les fourmilières présentent souvent, avant tout marquage, une certaine radioactivité très faible, due sans doute, d'après des recherches en cours, à la présence naturelle de potassium dont l'isotope 40 est naturellement radioactif.

36 Chauvin, R., Lecomte, J. LES ÉCHANGES SOCIAUX DU «DEUXIÈME DEGRÉ» CHEZ Formica polyctena. C.R. Acad. Sci., Paris 257, 20 (1963) 3049-51.

Les auteurs ont voulu étudier les échanges de glucides entre les différentes colonies (7) d'une «fédération» de F. polyctena. Le marquage a été effectué à l'aide de ^{198}Au mélangé à un demi-litre de sirop de sucre à 30% versé sur la fourmilière. Le sucre ingéré par une colonie n'est pas également distribué aux autres colonies auxquelles elle est reliée. Les mesures étaient effectuées au scintillomètre, en principe toutes les heures. Les mesures au compteur Edith montrent que la «charge» individuelle en isotopes des ouvrières peut varier énormément, ce qui interdit les comparaisons trop poussées entre le taux de transfert de l'isotope et l'activité brute sur les pistes. L'échange de glucides est assez limité.

37 Courtois, G., Lecomte, J., Salleron, F. ÉTUDE DES ÉCHANGES DE NOURRITURE À L'INTÉRIEUR DE LA RUCHE ENTRE LES ABEILLES OUVRIÈRES Apis mellifica L. C.R. Acad. Sci., Paris 252, 7 (1961) 1057-9.

Trois essais ont été effectués, en utilisant une ruche expérimentale de Chauvin, décrite en détail. Une population de 3 à 4000 abeilles l'occupaient. Les essais ayant été effectués durant les mois de décembre et de janvier, il n'y avait pas de couvain. Au moment des essais, la grappe était bien formée. Avec sa période de 2,7 j et son émission γ de 0,411 MeV, ^{198}Au présente un intérêt particulier pour ce type de recherches. Un petit nombre d'abeilles (5-10) devenait radioactif (par voie d'un nourrisseur contenant

~0,5 ml de miel marqué à ^{198}Au), la radioactivité introduite dans la ruche ne dépassant pas quelques microcuries. Les trois essais ont donné des résultats très parallèles. Les échanges de nourriture ne se font pas à partir du nourrisseur vers le centre de la grappe mais il apparaît de manière certaine que les ouvrières, après avoir empli leur jabot de miel, se dirigent très rapidement vers le centre de la grappe, en ne procédant ainsi qu'à des échanges très restreints. C'est de ce point privilégié que s'effectue la diffusion de la nourriture à travers l'ensemble de la population.

38 Courtois, G., Lecomte, J. ÉTUDE DES ÉCHANGES DE NOURRITURE ENTRE BUTINEUSES DE *Formica polyctena* TRAVAILLANT DANS DES SECTEURS DIFFÉRENTS MAIS APPARTENANT A LA MÊME FOURMILIÈRE. *Insectes sociaux 9* (1962) 323-7.

Un marquage à l'or radioactif de butineuses de *F. polyctena* a été effectué le long d'une piste de butinage. Les auteurs ont constaté que les échanges de nourriture étaient très faibles entre ouvrières travaillant sur des pistes différentes. (Aut.)

39 Courtois, G., Lecomte, J. QUELQUES EMPLOIS DES RADIOÉLÉMENTS ET DES RAYONNEMENTS EN ENTOMOLOGIE. p.5-21 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Le mémoire passe en revue les applications des radioéléments en entomologie qui ont été mises au point au CEN et à l'INRA durant ces dernières années. Les premiers travaux concernèrent l'abeille, plus particulièrement la dispersion des butineuses en provenance d'une colonie; l'étude a été réalisée par des marquages à ^{198}Au. Suite à ces considérations sur la dose reçue par l'individu dans de tels marquages, la radiorésistance de l'abeille a été déterminée et la dose létale estimée à 90 kr environ. ^{198}Au a également servi à étudier les échanges de nourriture à l'intérieur d'une ruche. Par contre, c'est ^{32}P qui fut utilisé pour des études d'échanges de nourriture à l'intérieur de ruchettes entre individus de fonctions (mâles, ouvrières, reines) ou de colonies différentes. Des études analogues de trophallaxis ont récemment été faites sur des guêpes. ^{198}Au a été également le radioélément de base de travaux sur les fourmilières. Le résultat le plus intéressant d'une première étude a été la découverte d'échanges de nourriture entre fourmilières distantes de plus de 50 m et d'espèces différentes (*Formica rufa* et *Formica polyctena*). Dans une deuxième étude, par marquage d'un chemin de fourmis et non de la fourmilière elle-même, on a mis en évidence une division des responsabilités à l'intérieur de la fourmilière, les fourmis marquées prospectant toujours le même chemin et n'ayant que peu d'échanges avec les autres individus de la même colonie. Dans cette même expérience, on a constaté avant tout marquage une radioactivité anormale des fourmis, due notamment à ^{95}(Zr + Nb). Cette découverte aurait tendance à montrer un amassage des retombées radioactives dans les fourmilières. En période de faibles retombées, une radioactivité naturelle attribuée au ^{40}K avait été constatée et avait servi à faire un dosage du potassium dans les fourmis et dans les abeilles. Un essai de marquage d'acridiens à ^{192}Ir a été fait. Enfin, une étude de la répartition de certains radioisotopes (^{32}P, ^{35}S) dans le corps de l'abeille au moyen de la méthode autoradiographique a été effectuée. (Aut.)

40 Dajoz, R. LA «TROPHALLAXIE» DES FOURMIS ÉTUDIÉE PAR LES RADIOISOTOPES. *Nature*, Paris *3328* (1962) 345. (In French).

Revue des publications récentes.

41 Gösswald, K., Kloft, W. UNTERSUCHUNGEN ZUR AUSSCHEIDUNG RADIOAKTIV MARKIERTER STOFFE BEI AMEISEN UNTER VERGLEICH VEREINZELTER TIERE MIT GRUPPEN. (Study on the elimination of radioactively labelled ants by individuals and groups). p.9-17 in "Symposia Genetica et Biologica Italica. Atti del IV Congresso dell' U.I.E.I.S. Pavia, 9-14 Settembre 1961. Vol.XII, Pavia, Tipografia del Libro S.A.S. 1963. (In German, with English summary).

Drosophila virilis, *Formica nigricans* Emery and *Myrmica scabrinodis* Nyl were labelled with saturated sucrose solution to which NaI^{131} had been added (specific activity 1 mc/ml). Sources of error are discussed. Ants were tested either singly or in groups of 5-15 workers. It was found that individual workers excrete the labelled substances at twice the rate of those in worker groups, indicating that I^{131} circulates longer in groups. A comparison of biological half-life thus offers a method of expressing group effects numerically.

42 Gösswald, K., Kloft, W. TRACER EXPERIMENTS ON FOOD EXCHANGE IN ANTS AND TERMITES. p.25-40 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Trophallactic food exchanges can be studied by the use of labelled food. In comparative studies, the most rapid rate of exchange was found in honeybees, but extreme differences were observed among the different subfamilies of ants to be considered in a field experiment. The greatest tendency towards trophallactic exchanges was found in the subfamily *Camponotinae*. Ants of the genus *Formica*, especially *Formica polyctena* Först. and related polygenous and polycalous species known to be important factors in the preventive biological control of forest insect pests were intensively analysed. It was found that the rate of food exchange within one nest is conditioned by temperature, time, the number of individuals, and saturation. Intensive food exchanges with different nests in the colony, up to distances of 200 m, were observed by labelling single nests with radioactive food. The collected food flows in most of the surrounding nests of the colonies of the useful wood ant, thus acting as a complex system with high ecological effectiveness. Termites (*Kalotermes flavicollis* Fabr.) were given labelled food in order to study which stages and castes are capable of direct feeding or are receptors of stomodeally or proctodeally given trophallactic food. Pseudoworkers are most effective. Tracer (I^{131}) was found to remain longer in groups (viewed as a unit) than in isolated individuals and can be explained by the measured trophallactic exchanges of food and repeated circulation among members of a group. Similar results were obtained with 2 ant species from different subfamilies. (Note: termites living in groups are more aggressive and live longer than isolated individuals). - Special problems of comparable measuring techniques for groups and isolated insects are discussed.

43 Kneitz, G. TRACERVERSUCHE ZUR FUTTERVERTEILUNG BEI WALDAMEISEN. (Tracer studies of food distribution in forest ants). p.38-50 in "Symposia Genetica et Biologica Italica. Atti del IV Congresso dell' U.I.E.I.S. Pavia, 9-14 Settembre 1961. Vol.XII, Pavia, Tipografia del Libro S.A.S. 1963. (In German, with English summary).

P^{32}-labelled honey was fed to individual workers of different species of forest ants (*Formica rufa* L., *Formica polyctena* Först., *Formica nigricans* Emery and *Formica exsecta* Nyl.). Marked individuals were released in groups of workers under defined conditions. The number of workers to whom radioactive food was transferred was found to vary with time, temperature, number of ants in the group, starvation and quantity of food offered. No food is taken up by hibernating workers. The results are shown graphically and discussed in relation to the biology and life-cycle of the forest ant colony.

44 Lecomte, J. ÉTUDE DES ÉCHANGES DE NOURRITURE DE LA COLONIE DE BOURDONS AU MOYEN DE RADIOISOTOPES. *C.R. Acad. Sci.*, Paris *257*, 23 (1963) 3664-5.

Une ouvrière d'une colonie de bourdons (*Bombus hypnorum*), maintenue en captivité et s'alimentant sur un nourrisseur contenant de l'eau miellée, reçut, à l'aide d'une pipette, une dizaine de mm^3 de miel contenant quelques μc d'or, ^{198}Au. 1 h après le marquage, 6 sur 9 individus se révélaient positifs; dans les 6 h suivant le marquage, 28 sur 54 (51%) avaient reçu de la nourriture venant d'une seule ouvrière. Une prospection de l'intérieur du nid a permis de constater que la reine avait activement participé à cette distribution et que, d'autre part, un «pot à miel» était fortement actif. On peut donc supposer l'existence d'une trophallaxie indirecte. L'hypothèse sur le rôle du pot à miel dans cette trophallaxie indirecte a été renforcée par un marquage similaire, effectué sur une ouvrière appartenant à une colonie de *Bombus terrestris* qui ne comportait pas de pots à miel. Il fut impossible de déceler par la suite la moindre trace de radioactivité due à un échange de nourriture.

45 McMahon, E.A. NEW RADIOACTIVE TESTS SHOW HOW TERMITES FEED. *Pest Control 31*, 2 (1963) 32-4.

A study of food exchange between *Cryptotermes brevis* individuals by the tracer technique using radioisotopes. Termites made radioactive by feeding on wood that had been soaked in a radioisotope solution were paired with non-radioactive termites. The amount of food acquired by the non-radioactive recipients from radioactive nymphs could be measured by the increase in radioactivity. The author calls attention to the fact that the habit of food exchange between members of a termite colony offers a way of distributing poison throughout a colony. (BA 43:1963, 12048)

46 McMahon, E.A. A STUDY OF TERMITE FEEDING RELATIONSHIPS, USING RADIOISOTOPES. *Ann. ent. Soc. Amer. 56*, 1 (1963) 74-82.

Food exchange relationships of large (N) and small (n) nymphs were studied in a drywood termite, Cryptotermes brevis (Walker). Nymphs of both sizes were allowed to feed for 5 d on wood that had been labelled with either Sr^{85} or Co^{57}, and were then confined as "donors" with non-radioactive N and n recipients in non-radioactive termitaries. After 2 d comparisons were made of relative amounts of radioactivity acquired by N and by n recipients when confined with N as opposed to n as donors. Large and small nymphs appeared to feed at approximately the same rate when relative size was taken into account. Soldiers and supplementary reproductives had smaller feeding capacities than had nymphs of the same weight, although differences in radioactivity acquired may also have reflected relative numbers of microorganisms in the hindgut. Termite size did not appear to influence feeding relationships under the experimental conditions. Sr-labelled donors lost a much larger percentage of their nuclide via pellets than did Co-labelled donors; Sr tended to be concentrated in the Malpighian tubules, Co in the hindgut. It is suggested that the symbiotic protozoa and bacteria concentrated Co. Pellet production was at the rate of about 0.65 pellets/termite/d. Soldiers confined in radioactive termitaries only become radioactive when a nymph is also present, supporting past observations that soldiers are entirely dependent on colony mates for food. The molting phase, as expected, affected the amount of radioactivity acquired and donated, with cessation of pellet production. (From auth.)

47 Naarmann, H. UNTERSUCHUNGEN ÜBER BILDUNG UND WEITERGABE VON DRÜSENSEKRETEN BEI Formica (Hymenopt. Formicidae) MIT HILFE DER RADIOISOTOPENMETHODE. (A study on formation and transmission of glandular secretions in Formica (Hymenopt. Formicidae) by means of a radioisotope technique). Experientia 19, 8 (1963) 412-3. (In German, with English summary).

A technique was elaborated for studying food-secretion. Ants of Formica polyctena Först and F. nigricans Em. were labelled with P^{32}. The secretion was found to be mainly formed in the pharyngeal gland, whence it reaches the crop through the exit channel of the gland, where it is stored. On regurgitation stimuli it is released again to female and male ants, and to larvae as well as workers.

48 Nordau, C.G. L'ABEILLE ET LA RADIOACTIVITÉ. Industr. atomiques 6, 3/4 (1962) 75-84.

Cet article apporte quelques précisions sur l'état actuel des recherches effectuées par M.J. Lecomte, Mlle F. Salleron et M.G. Courtois concernant le marquage à ^{198}Au, sur la radiorésistance de l'abeille, sur les aspects d'ensemble du butinage et sur les échanges de nourriture à l'intérieur de la ruche. ^{198}Au se répand un peu partout mais se fixe en majeure partie dans le tube digestif. Il est presque toujours peu évacué. L'or en suspension colloïdale se mélange bien au sirop à 50% (ramené à pH 5,5 avec l'acide tartrique). Si l'on introduit 40 mc dans une ruche normale comportant 40 000 abeilles, chaque abeille recevrait une dose totale de 600 r pendant 3 j. Des expériences sur la sensibilité aux rayons X ont été faites sur Blabera fusca Br. (25 000 et 10 000 r), et sur l'abeille avec 450 c de ^{60}Co. Selon Courtois et Lecomte, la dose de 90 000 r se trouve la première à se manifester nocive d'une manière nettement significative. Seulement après 39 h les abeilles arrivent à se déplacer mais restent incapables de voler. L'état physiologique de l'abeille influe fort sa radiosensibilité. Les butineuses ne s'éloignent pas beaucoup de la ruche (< 1,5 km à vol d'oiseau, la plupart restent à 500 ou 600 m). En automne les abeilles sont actives et le centre de diffusion n'est plus à l'endroit de la reine. Les échanges hivernaux de la nourriture sont plus lents qu'en d'autres saisons. - Les abeilles semblent s'habituer à la longue, par la fréquentation, à négliger les différences d'origine.

49 Stumper, R. RADIOBIOLOGISCHE UNTERSUCHUNGEN ÜBER DEN SOZIALEN NAHRUNGSHAUSHALT DER HONIGAMEISE Proformica nasuta (Nyl). (Radiobiological study on the social feeding organization of the honey ant, Proformica nasuta (Nyl).) Naturwissenschaften 48, 24 (1961) 735-6. (In German).

The ant is markedly polymorphous, the workers consisting of minor, major and major-repleta forms. P^{32}-labelling was used in this study. The investigation showed that (1) the tendency for independent and secondary food-uptake was subject to marked individual fluctuations, and (2) honey-intake increased with body size. P. nasuta was found to be supremely well adapted to its exothermic environment. The food requirements appear extraordinarily low. The honey supply of 10 mg of one repleta suffices for 100 workers for the period of 30 d, allowing 4.1×10^{-3} cal/nasuta worker/d or, in terms of body weight, 3 cal/g. (Note that a bee in 24-h-flight uses 240 mg carbohydrate or 984 cal/d or 9840 cal/g. According to G. Schmidt, Würzburg, a value of 60 cal/g has been determined for a resting Formica polyctena worker at 28°C).

See also:

- 50 Comparative study on some aspects of the behaviour of Polyergus rufescens Latr. and Raptiformica sanguinea Latr. (Beck, 1961)
- 57 Sur les échanges entre fourmillières de deux espèces différentes mis en évidence par les radioisotopes. (Chauvin, et al., 1961)
- 58 Étude au moyen des radioisotopes des échanges de nourriture entre reines, mâles et ouvrières d'Apis mellifica L. (Delvert-Salleron, 1963)
- 60 Étude préliminaire des relations entre les adultes et le couvain chez les guêpes sociales du genre Vespa au moyen d'un radioisotope. (Montagner, 1963)
- 61 Données nouvelles sur le comportment alimentaire et les échanges trophallactiques chez les guêpes sociales. (Montagner and Courtois, 1963)
- 62 Queen bee food juices of the honey bee. V. Formation of the food in the nurse bee. (Rembold and Hanser, 1960)

I-A-2-c GENERAL BEHAVIOUR

50 Beck, H. VERGLEICHENDE UNTERSUCHUNGEN ÜBER EINIGE VERHALTENSWEISEN VON Polyergus rufescens Latr. und Raptiformica sanguinea Latr. (Comparative study on some aspects of the behaviour of Polyergus rufescens Latr. and Raptiformica sanguinea Latr.). Insectes sociaux 8, 1 (1961) 1-11. (In German).

An attempt was made to obtain quantitative results on the degree of social-parasitic degeneration or modification in the behaviour of the ant P. rufescens compared with R. sanguinea. Experiments with P^{32}-labelled honey showed that P. rufescens is capable of independent feeding but that it is insufficient for complete nutrition. In feeding-tests with food-bearers, P. rufescens took far less honey than did R. sanguinea. Trophallaxis (distribution of food and other substances in a colony) thus takes place only to a very limited extent in P. rufescens. In experiments with Serviformica pupae, behavioural differences were marked. Whereas R. sanguinea transported 3½ times as many pupae as dummies and stocked them in piles away from the light, P. rufescens only made half the number of trips, picked up an excess of dummies, and showed no collecting instinct.

51 Hay, C.J., Myser, W.C. USE OF P^{32} AS AN AID IN BIOLOGICAL STUDIES OF THE LEAFHOPPER, Scaphoideus luteolus. J. econ. Ent. 54, 6 (1961) 1260-1.

In an attempt to trace the oviposition habits of Scaphoideus luteolus Van Duzee, the vector of elm phloem necrosis, elm trees (Ulmus spp.), 1.5-2 ft tall and having at least 2 stems, were made radioactive by introducing P^{32} in solution into the cut end of one of the stems. Late-instar nymphs were caged on the treated plants. Once adult, the males were destroyed, and females registering at least 5000 cpm were released with non-radioactive males in cages containing elm plants and bolts (3 x 24 in). They laid radioactive eggs 8-30 d after mating, and possibly later, in the corky layer of the bark on the elm bolts. The leafhoppers showed no ill effects. More activity could probably be attained in the eggs if the females had been kept on the activated elm plants for 2 to 4 weeks past the nymphal stage. After mating, it appears to take several weeks for the eggs to develop and oviposition to begin.

52 Liu, H., Lee, S.M., Teng, W.S. STUDIES ON THE BEHAVIOR OF LARGE LADYBIRD (Synonycha grandis Thunberg) IN SUGARCANE FIELD BY RADIOISOTOPE TECHNIQUE. I-II. Rep. Taiwan Sug. Exp. Sta. 31 (1963) 83-105. (In Chinese, with English summary).

Effective natural enemy of woolly aphid Ceratovacuna lanigera Zehnt. (B. Ag. 27: 1963, 103052).

53 Quraishi, M.S. USE OF ISOTOPES FOR INVESTIGATING THE BEHAVIOUR AND ECOLOGY OF INSECT PESTS IN SOME RECENT STUDIES. p. 93-8 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Anopheles stephensi, the main vector of malaria in southern Iran, was labelled with P^{32} and the dispersal, behaviour, digestion of blood meal, maturation of ovaries and length of gonotrophic cycles studied. It was found that about 80% of Anopheles needed two blood meals for completing the 1st cycle (4-5 d, depending on temperature). Labelled mosquitoes which had emerged overnight were released in an isolated village. From the ratio of active mosquitoes to toal catch/d and on the assumption that the natural population remained constant, the mortality rate was determined and found to be exponential for the first

6 d. The mating behaviour of the female was also studied by using normal females which had mated once with P^{32}-labelled males. The female mates more than once and after mating the spermatheca become active. Counts up to twice the background (12 cpm) were obtained with males of 15 000 cpm. Saliva injected by P^{32}-labelled mosquitoes into glucose solution was studied. - The feeding behaviour of Eurygaster integriceps Put. was studied on P^{32}-labelled wheat plants. Other foods (labelled) were also studied; feeding is evidently essential for the first moult.

54 Quraishi, M.S., Arthur, M. MATING BEHAVIOUR OF Anopheles stephensi. Nature, Lond. 197, 4864 (1963) 312-3.

The possible application of the sterile-male technique to Anopheles stephensi is considered, particularly in view of its marked resistance to DDT, BHC, and dieldrin. It seemed feasible since (1) it can be easily reared in the laboratory, (2) male and female are easily separated mechanically in the pupal stage, (3) males are powerful fliers (up to 4.3 km) and form big swarms for mating, (4) the males are completely harmless, and (5) the longevity of the sexes is comparable. As a preliminary, the mating behaviour of the female was studied by using P^{32}-labelled males of 7000-13 000 cpm activity; (3rd and 4th instar larvae were labelled in water containing 10-20 μc P^{32}/1 giving rise to adults of 2 500 - 38 000 cpm activity). Spermathecal radioactivity was recorded. Females clearly mate more than once.

55* Riordan, D.F. THE LOCATION OF THE NESTS OF CARPENTER ANTS (Camponotus spp., Hymenoptera-Formicidae) BY MEANS OF A RADIOACTIVE ISOTOPE. Insectes sociaux 7, 4 (1960) 353-5. (In English).

I^{131} was used, since its γ-radiation penetrates wood, and its 8-d half-life reduces radiation hazards. Overwintering larvae of the sawfly, Neodiprion lecontei (Fitch) were selected as suitable prey. Storage at a low temperature had made the larvae sluggish and they were further immobilized by short immersion in water at 140°F. As the body tissues of these larvae had shrunk through dehydration, a relatively large amount of fluid could be injected into them. The I^{131}-solution was used at 300 μc/ml and 16 μl were injected into each larva, each thus carrying 4.8 μc of I^{131}. A portable scintillation counter was used, capable of detecting 3 μc I^{131} through 5½ inches of wood. Ants and their nests could thus be traced as ants appropriated their prey and removed it to their nests. The usefulness of the method also for ecological studies is stressed.

56 Schmidt, C.H., Smith, C.N. THE ROLE OF RADIONUCLIDES IN INSECT BEHAVIOR STUDIES. p.441-3 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.

Experiments are presented to illustrate the role of radionuclides in insect behaviour studies. Adults of lone star ticks, Amblyomma americanum (L.), were dipped in a solution containing Fe^{59}, released in the field and their dispersion pattern followed over an 11-week period. Sperm from 2 species of mosquitoes (Aëdes aegypti (L.) and Anopheles quadrimaculatus Say) were labelled by introducing P^{32} into the 3rd-instar larval medium. When the males mated with normal females, radioactivity could be detected in the spermathecae. Treating blood or a membrane with P^{32} revealed that A. aegypti females reacted differentially to 2 concentrations of diethyltoluamide in blood. Addition of P^{32} to honey solution revealed that at least 3 d were necessary for all A. aegypti adults in a cage to feed. Malathion-resistant houseflies showed a definite behavioral resistance (avoidance) as well as physiological resistance to Malathion sugar baits labelled with P^{32}, demonstrated by avoidance reaction of the females.

See also:

13 Field studies of the daily activity and feeding behaviour of Sunn pest, Eurygaster integriceps Put., (Hemiptera, Scutelleridae) on wheat in North Iran. (Banks, et al., 1961)
39 Quelques emplois des radioéléments et des rayonnements en entomologie. (Courtois and Lecomte, 1963)
48 L'abeille et la radioactivité. (Nordau, 1962)
78 Distribution of foragers from honey bee colonies placed in the middle of a large field of alfalfa. (Levin, 1961)
1375 The importance of competitiveness of radiosterilized males in mosquito-control programmes. (Dame and Schmidt, 1962)

I- A- 2- d SOCIAL BEHAVIOUR

57 Chauvin, R., Courtois, G., Lecomte, J. SUR LES ÉCHANGES ENTRE FOURMILIÈRES DE DEUX ESPÈCES DIFFÉRENTES MIS EN ÉVIDENCE PAR LES RADIOISOTOPES. C.R. Acad. Sci., Paris 252 (1961) 4060-1.

^{198}Au (50 mc), mélangé à un sirop de sucre concentré, a été versé sur une fourmilière de Formica polyctena établie dans un bois au milieu d'une dizaine de nids de F. rufa. Après 24 h, et surtout après 36 h, on a pu constater l'existence d'une radioactivité incontestable dans trois fourmilières de F. rufa éloignées de 30 à 60 m de celle de F. polyctena. Il paraît peu probable que la contamination des rufa puisse se faire en traversant seulement les pistes de polyctena, ni qu'une régurgitation des matières radioactives auprès des pucerons (régurgitation ensuite absorbée par les ouvrières de rufa) en soit responsable. Le fait que les pistes de polyctena soient inactives aussi bien que leurs pattes supporte l'hypothèse d'un contact buccal avec échange de nourriture entre polyctena et rufa, bien qu'elles soient d'espèces differentes. La rapidité avec laquelle des rapports s'établissent (24 h environ) paraît un argument de plus en faveur d'une telle transmission.

58 Delvert-Salleron, F. ÉTUDE AU MOYEN DES RADIOISOTOPES DES ÉCHANGES DE NOURRITURE ENTRE REINES, MÂLES ET OUVRIÈRES D'Apis mellifica L. Ann. Abeille 6, 3 (1963) 201-27.

Le marquage à ^{32}P était effectué par une solution de $NaH_2P^{32}O_4$ ajoutée aux aliments. Pendant les premières 48 h on a pu constater une certaine préférence des nourrices entre elles. Plus tard, on a pu voir que les mâles se montrent capables de se nourrir eux-mêmes, malgré une préférence à être nourris par les ouvrières. Les ouvrières reçoivent de la nourriture soit par alimentation directe, soit par voie d'ingestion de matière régurgitée. Les reines transmettent de la nourriture ou des substances qui contiennent des radioisotopes aux ouvrières; dans un groupe bien limité, certaines ouvrières privilégiées ont pu participer davantage. L'auteur donne quelques précisions sur la méthodologie nucléaire (technique de mesure, compteur GM type cloche, etc.) employée.

59 Kloft, W. PROBLEMS OF PRACTICAL IMPORTANCE IN HONEYDEW RESEARCH. Bee World 44, 1 (1963) 13-18, 24-29.

The possibility and desirability of exploiting coniferous forest resources in terms of honeydew production, as a means of offsetting the decrease in honey yields from modified agricultural practices, are reviewed. The following aspects require detailed consideration: (1) the plants producing phloem sap rich in carbohydrates, (2) the plant-sucking insects which excrete the honeydew, and (3) the bees which use it as a source for making honeydew honey. The part played by wood ants in stabilizing honeydew production is very important, and considerable work on it is cited. - Radioisotopes, although used in some of these studies, have not been mentioned specifically in the text.

60 Montagner, H. ÉTUDE PRÉLIMINAIRE DES RELATIONS ENTRE LES ADULTES ET LE COUVAIN CHEZ LES GUÊPES SOCIALES DU GENRE Vespa AU MOYEN D'UN RADIOISOTOPE. Insectes sociaux 10, 2 (1963) 153-66. (In French, with German summary).

Au moyen d'incorporation de l'or radioactif (^{198}Au) en solution colloïdale dans la nourriture de l'espèce Paravespula vulgaris ou P. germanica, une certaine orientation a été mise en évidence dans les tâches chez les ouvrières, au sein de petites colonies artificielles. Il est apparu nettement que la larve était nourrie de façon constante en fonction de son degré d'évolution. La taille et l'intégrité de la cellule interviennent également. Les larves d'ouvrières sont bien approvisionnées à une époque caractérisée par l'apparition du couvain abortif, alors que les nourrices disposent d'une source de nourriture abondante. Mais, si les larves sont élevées en concurrence avec du couvain de fondatrices, elles sont moins bien nourries et parfois négligées, au bénéfice de ces dernières. Il est donc probable que la quantité de nourriture distribuée aux larves peut influencer ou même provoquer leur différenciation en ouvrières ou en fondatrices. - L'auteur n'a jamais pu constater une véritable attraction ou exploitation des régurgitations des larves par les ouvrières. Il est donc hasardeux de conclure que la société de guêpes doit sa survie à l'attrait de ces «sécrétions».

61 Montagner, H., Courtois, G. DONNÉES NOUVELLES SUR LE COMPORTEMENT ALIMENTAIRE ET LES ÉCHANGES TROPHALLACTIQUES CHEZ LES GUÊPES SOCIALES. C.R. Acad. Sci., Paris 256, 19 (1963) 4092-4.

La technique utilisée est celle de Courtois et Lecomte (C.R. Acad. Sci. 247 : 1958, 147) pour marquer des insectes de genre Vespa avec de l'or (^{198}Au) en solution colloïdale, telle que chaque individu absorbe l'équivalent de 1 µc. Les échanges de nourriture se font plus facilement entre les ouvrières de la même colonie mais ce comportement s'estompe avec le temps (2 j). Tous les jeunes mâles s'alimentent bien d'eux-mêmes. Les capacités d'alimentation des mâles diminuent avec l'activité du nid et l'apparition des fondatrices filles. Elles reprennent après les fécondations. Les mâles se nourrissent essentiellement en sollicitant les régurgitations des larves. Les larves de fondatrices sont nourries davantage que celles d'ouvrières. Il est probable que la quantité de nourriture donnée aux larves joue, seule, un rôle dans la différenciation des deux castes femelles.

62* Rembold, H., Hanser, G. QUEEN BEE FOOD JUICES OF THE HONEY BEE. V. FORMATION OF THE FOOD IN THE NURSE BEE. Hoppe-Seyl. Z. 319 (1960) 206-12.

The presence of 10-hydroxy-2-decenoic acid, biopterin, and purines was demonstrated in the pharyngeal glands, but not in the labial glands of nurse bees. Biopterin-2-C^{14} fed to nurse bees was incorporated into the pharyngeal glands. Pollen contains no biopterin, and bees do apparently not require it in the diet. The joint functioning of the pharyngeal and mandibular glands in the production of the bee food is discussed. (CA 55: 1961, 23851F)

See also:

12 Some recent studies, involving the use of radioisotopes, of the feeding behaviour of two phytophagous insects. (Banks, 1962)
34 Echanges trophallactiques chez un termite supérieur. Contamination par le phosphore radioactif de la population d'un nid de Cubitermes fungifaber. (Alibert, 1963)
35 Sur la transmission d'isotopes radioactifs entre deux fourmilières d'espèces différentes (Formica rufa et Formica polyctena). (Chauvin et al., 1961)
36 Les échanges sociaux du "deuxième degré" chez Formica polyctena. (Chauvin and Lecomte, 1963)
38 Etude des échanges de nourriture entre butineuses de Formica polyctena travaillant dans des secteurs différents mais appartenant à la même fourmilière. (Courtois and Lecomte, 1962)
39 Quelques emplois des radioéléments et des rayonnements en entomologie. (Courtois and Lecomte, 1963)
40 La «trophallaxie» des fourmis étudiée par les radioisotopes. (Dajoz, 1962)
44 Etude des échanges de nourriture de la colonie de bourdons au moyen de radioisotopes. (Lecomte, 1963)
50 Comparative study on some aspects of the behaviour of Polyergus rufescens Latr. and Raptiformica sanguinea Latr. (Beck, 1961)
271 Royal jelly of the honeybee. VI. Metabolism of biopterins in the honeybee. (Rembold and Hanser, 1960)
458 Marquage radioactif des fourmis dans les plantations d'ananas. (Mortreuil and Brader, 1962)
41 Study on the alimentation of radioactively labelled ants by individuals and groups. (Gösswald and Kloft, 1963)

I-A-3 POPULATION DYNAMICS

(Dispersal, Flight Range, etc.)

63* Андреев, С.В., Воеводин, А.В., Молчанова, В.А., Хотянович, А.В. НЕКОТОРЫЕ РЕЗУЛЬТАТЫ ПРИМЕНЕНИЯ РАДИОАКТИВНЫХ ИЗОТОПОВ ДЛЯ ЗАЩИТЫ РАСТЕНИЙ Стр. 322-34 в сб. "Труды Второй Международной Конференции по мирному использованию атомной энергии", т.6 "Получение и применение изотопов" (Доклады советских ученых). М., Атомиздат. 1959.

Andreev, S.V., Voevodin, A.V., Molchanova, V.A., Khotyanovich, A.V. SOME RESULTS OF THE USE OF TRACER TECHNIQUES IN THE STUDY OF PLANT PROTECTION. p.85-92 in "Proceedings of 2nd International Conference on the Peaceful Uses of Atomic Energy" Vol.XXVII Geneva, United Nations, 1958. A/CONF.15/P/2309.

Some of the results of studies carried out at the All-Union Institute of Plant Protection at Leningrad are presented in sections dealing with plant intoxication, insect toxicology, rodent toxicology, herbicides and insect ecology. The uptake, translocation and accumulation of labelled systemic insecticides were investigated on cotton and cucumber. Parathion and its methyl analogue were studied in detail. The first stage of decomposition of parathion was found to consist of isomerization of the initial preparations with subsequent formation of isomers with anticholinesterase activity. In insect toxicology studies, a contact organosulphur insecticide (S^{35}-labelled) and an intestinally-acting organophosphorus insecticide (P^{32}-labelled) were used on the Asiatic locust, Locusta migratoria L. The rate of penetration into the organism, the localization within different organs and tissues, and the kinetics of the preparations within the insect were studied. Microautoradiography was used. - Eurygaster integriceps Put. was labelled with Co^{60} by dipping in the chloride to which some wetting agent (OP-7) had been added. An activity of 0.37 µc was thus available, exposing the insect to 720 r over 8 months. The first 3 instars were more conveniently labelled by feeding on P^{32}-labelled wheat shoots. The principal directions of migration and breeding and assembly grounds were studied. The mobility of the insects was clearly connected with their physiological condition as characterized by the fat index.

64 Андреев, С.В., Молчанова, В.А., Мартенс, Б.К. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ ДЛЯ МАРКИРОВКИ БАБОЧЕК ЗЕРНОВОЙ СОВКИ. Зоол. Ж. 41, 1 (1962) 84-91.

Andreev, S.V., Molchanova, V.A., Martens, B.K. USE OF RADIOACTIVE ISOTOPES FOR TAGGING Hadena sordida Skh. MOTHS. Zool. Zh. 41, 1 (1962) 84-91. English Translation: Fed. Proc. 22, 5, Pt.II (1963) T825-8.

A combination of photo and chemotaxis was used for trapping, leading to a "self"-labelling of the insects. An electric trap (ESLU-2) was operated with an ordinary bulb or a PRK-4 tube. The light source was surrounded by a wire net consisting of 2 parallel rows of wire maintained at 3000 V. A removable hood with aromatic substances was placed underneath the net. The short circuits caused by the insect on entering the net caused it a shock, the insect then falling into a funnel and thence into a gauze sack. For tagging, the gauze was dipped into melon syrup with a solution of doubly substituted, P^{32}-labelled sodium phosphate. The majority of moths fly relatively short distances in windless weather at 15-25°C. In fields edged by a forest belt a maximum distance of 100 m was observed, the range dropping sharply beyond it. Forest belts are a considerable hindrance to the migration. In experiments on the maximum range of migration, the highest percentage of moths was found at 0.5-2 km. When studying wind effect on migration range, individuals were found up to 12 km from the release point, a distance greater than could be explained by air currents and wind alone.

65 Eddy, G.W., Plapp, F.W., Jr., Roth, A.R. STUDIES ON THE FLIGHT HABITS OF SOME MARKED INSECTS. J. econ. Ent. 55, 5 (1962) 603-7.

Several thousand P^{32}- and fluorescent-marked stable flies (Stomoxys calcitrans (L.)), several hundred horn flies (Haematobia irritans (L.)), and houseflies (Musca domestica L.), and several thousand mosquitoes (Culex tarsalis Coquillet, C. peus Speiser, and Aëdes dorsalis (Meigen)) were released in Lake County, Oregon, in September 1961. Efficient labelling was achieved by placing P^{32} in the diet of the insects at the rate of 1 µc/ml. The percentage of insects that had fed on P^{32}-treated food and the amount of radioactivity were determined by a proportional scaler. Data are tabulated. Both stable flies and horn flies were effectively labelled; the total activity per fly, however, was higher with the stable flies. Both blood and sugar feeding were equally effective. Less success was experienced in labelling mosquitoes. As shown in the results, Culex peus reached higher levels of total radioactivity per insect than C. tarsalis; the latter were, however, considerably older at the time of labelling. Marked stable, house, and horn flies were recovered 1 and 5 miles from the release site. Activity of mosquitoes was apparently curtailed by low nightly temperatures since none were caught. The stable flies showed the most rapid dispersion, specimens being recovered 5 miles from the release point in slightly less than 2 h.

66 Elmore, C.M., Jr., Schoof, H.F. DISPERSAL OF Aëdes taeniorhynchus Wiedemann NEAR SAVANNAH, GEORGIA. Mosquito News 23, 1 (1963) 1-7.

From the release of approx. 3 million P^{32}-tagged Aëdes taeniorhynchus near Savannah, Georgia, 415 females and 29 males were recovered in light traps located at distances up to 20 miles from the departure point. Recoveries beyond 4 miles did not occur until the 4th night after release. Female specimens were captured at distances up to 18 miles but more than 75% of the recoveries, exclusive of 1 trap 0.1 mile from the release point, were within 4 miles. The maximum distance at which males were trapped was 2 miles from the departure point. (Summary)

67 Féron, M. ÉTUDE DE LA SURVIE HIVERNALE DE DEUX INSECTES SANS DIAPAUSE *Ceratitis capitata* ET *Dacus oleae* (Dipt. *Trypetidae*) ET LEURS FACTEURS DE PULLULATION. (Rés.) *Ann. Epiphyt.* *13*, 4 (1962) 336.

Les méthodes de marquage des imagos utilisées ont été: amputation partielle d'une patte, absorption d'une solution colorée (de faible durée) et marquage radioactif (^{32}P).

68 Гаджей, Е.Ф. МИГРАЦИИ МУХ В УСЛОВИЯХ ГОРОДА. *Мед. Паразит.* *32*, 4 (1963) 465-8.

Gadzhei, E.F. FLY MIGRATION IN URBAN AREAS. *Med. Parazitol.* *32*, 4 (1963) 465-8.

A method convenient for the study of fly migrations in urban areas implies using P^{32} sprayed onto garbage collector walls and refuse as well as put into baits scattered all over apartment houses. Observations were carried out in a city district of the Central Tadjikistan. Most of the domestic flies migrate from their breeding places (dust and garbage bins) to houses lying at a distance of up to 30 m, but some of them fly to houses as far way as 250 m on the first day. Flies tagged in apartment houses are found on other premises. In the area with several dysentery cases on record, any sizable epidemiological and entomological effect can be achieved only by instituting fly control measures over the entire section under consideration, as well as at the breeding grounds within a zone lying 250 m beyond the boundary of the section. (Auth.)

69 Gillies, M.T. MARKING AND RELEASE EXPERIMENTS WITH A TROPICAL MOSQUITO BY THE USE OF RADIOISOTOPES. p.267-79 in "Radioisotopes in Tropical Medicine, Proceedings of a Symposium, Bangkok, 12-16 December 1960". Vienna, International Atomic Energy Agency. 1962.

Mosquitoes (*Anopheles gambiae*) were reared in the laboratory and labelled by introducing either P^{32} or S^{35} into the larval breeding pans. Releases were made in series, using the two isotopes in regular alternation. Recaptures were recognized by autoradiography. The particular isotopes present in each specimen (and hence the date of release) were identified by a simple method for discriminating between high and low energy β-particles. Of some 60 000 mosquitoes released 450 were recaptured. The recapture rate of females was 0.5%. Parallel experiments with mosquitoes marked with paint gave similar results. Mosquito movement could be shown to be non-random and related primarily to the distribution of human settlements. Marked females were recaptured up to 23 d after release and, surprisingly, a single male after 30 d. The use of radioisotopes for longevity studies appears to be limited to those species which can be collected in large numbers from natural waters, rather than obtained by artificial breeding.

70 Gillies, M.T. STUDIES ON THE DISPERSION AND SURVIVAL OF *Anopheles gambiae* Giles IN EAST AFRICA, BY MEANS OF MARKING AND RELEASE EXPERIMENTS. *Bull. ent. Res.* *52*, 1 (1961) 99-127.

Marking and release experiments were carried out in a coastal area of Tanganyika. Laboratory-reared mosquitoes were labelled with P^{32} or S^{35}, either by topical application or introduction of radioisotopes into the larval breeding pans. Recaptures were recognized by autoradiography. Recaptures were possible up to $2\frac{1}{4}$ miles. Of 132 000 mosquitoes released, 1019 were captured. Mean flight ranges were 0.64 mile for females and 0.52 mile for males; mean range of dispersion (females) 0.98 mile. Both sexes were captured at $2\frac{1}{4}$ miles. Dispersion was non-random and related primarily to the distribution of human settlements. Prevailing winds played a minor role. A relatively high level of mortality appears to be due to the use of laboratory-reared mosquitoes. The corrected sporozoite rate in marked females at time of recapture was 0.8%. The survival of males was only slightly lower than that of females. From the survival curve it appears that the mortality rate remained constant throughout the period in which marked females were recovered.

71 Jackson, W.B., Maier, P.P. ADDITIONAL STUDIES OF DISPERSION PATTERNS OF AMERICAN COCKROACHES FROM SEWER MANHOLES IN PHOENIX, ARIZONA. *Ohio J. Sci.* *61*, 4 (1961) 220-6.

Periplaneta americana (L.) were trapped, marked by spraying with a P^{32}-labelled solution, and released in manholes. Attempted recapture by traps indicated little or no movement in a winter experiment, even when 1500 cockroaches from elsewhere were added to 125 already in the manhole. In experiments in late spring, limited movement was recorded from an undisturbed population, but extensive emigration followed the addition of 2000 cockroaches to the 400 already present, marked roaches being recovered in neighbouring yards, blocks of flats, and manholes. About $\frac{1}{2}$ the recoveries in yards were made within 50 ft of the manhole into which the extra roaches had been released, but some were up to 200 ft away; 2 were even recovered from a manhole 475 ft downstream. These results indicate that a sudden increase in population may cause widespread emigration, and that some emigration may normally occur in spring and summer from populations that are readjusting themselves to the carrying capacity of their environment.

72 Katiyar, K.P., Valerio, S.J. ESTUDIOS SOBRE LA DISPERSIÓN Y LONGEVIDAD DE LA MOSCA DEL MEDITERRÁNEO *Ceratitis capitata* Wied., MARCADA CON P^{32}. (Studies on the dispersion and length of life of the Mediterranean fruit-fly *C. capitata* labelled with P^{32}). *Turrialba* *13*, 3 (1963) 181-84. (In Spanish, with English summary).

Adults from irradiated pupae were labelled by feeding them on a solution containing P^{32} and liberated in a narrow peninsula containing numerous abundantly fruiting trees of *Terminalia catappa* on the Pacific coast of Costa Rica. The flies were recovered for up to 26 d after release; the maximum distance at which recoveries were made was about 1420 yards, and 87.5% of the flies recaptured were collected from traps situated about 220 yards from the release point. In the presence of an abundance of host fruits, dispersion is thus not great.

73 Kettlewell, H.B.D., Heard, M.J. ACCIDENTAL RADIOACTIVE LABELLING OF A MIGRATORY MOTH. *Nature*, Lond. *189* (1961) 676-7.

A specimen of *Nomophila noctuella* L. was trapped at Oxford, and 3 others elsewhere in England. A consistent count of 15-20% above background was observed. A particle source was detected in the insect, represented by a perfect 9 μ-sphere, dark brown and typical of particles originating in the high temperature of test explosions, such as carried out in the Sahara desert. There is a high probability that the particle was acquired in Africa. The evidence suggests that the moth was able to cover a distance of approx. 1500 miles in the course of a short life.

74* Худадов, Г.Д. К ВОПРОСУ О ПРИМЕНЕНИИ РАДИОАКТИВНОГО ФОСФОРА ПРИ ИЗУЧЕНИИ МИГРАЦИИ МУХ ИЗ ЖИЛЫХ ПОМЕЩЕНИЙ. Стр. 319-24 в сб. "Труды Центрального НИИ дезинфекции", №11. 1959.

Khudadov, G.D. ON THE USE OF RADIOPHOSPHORUS TO STUDY THE MOVEMENT OF FLIES FROM INHABITED PREMISES. p.319-24 in "Transactions of the Central Institute for Scientific Research on Disinfestation", No.11, 1959.

75 Lecomte, J. TECHNIQUES D'ÉTUDE DES POPULATIONS D'INSECTES POLLINISATEURS. *Ann. Abeille* *5*, 3 (1962) 201-13. (In French, with English summary).

The study of populations of insect pollinators, chiefly the Apidae, requires employment of certain techniques. Those examined in this study are concerned essentially with the measurement of population densities and with the marking by means of radioisotopes of individuals and collections of individuals occurring in these communities.

76 Lecomte, J. MÉTHODES D'ÉTUDES SUR LA DYNAMIQUE DES POPULATIONS D'INSECTES, 1962. MÉTHODES D'ÉTUDE DES POPULATIONS D'INSECTES POLLINISATEURS. (Rés.). *Ann. Epiphyt.* *13*, 4 (1962) 333.

Voir 75.

77 Lee, W.R. THE NONRANDOM DISTRIBUTION OF FORAGING HONEY BEES BETWEEN APIARIES. *J. econ. Ent.* *54*, 5 (1961) 928-33.

How distance affects the distribution of foraging honey bees (*Apis mellifera* L.) was studied without having the results confounded by variation in the food supply. In the first experiment colonies were positioned at two locations 1,925 feet apart in a low-bush blueberry (*Vaccinium lamarckii* Camp) field; in the second experiment the colonies were 800 feet apart in an apple orchard. Bees from each apiary were distinguished by either genetic markers or P^{32}. The ratio of bees from one apiary to bees from the other was determined at various distances between the two apiaries. In both experiments the ratio of bees from Apiary A to bees from Apiary B increased significantly as the distance to Apiary A decreased. Regression analysis showed that this was due to both an increase in bees from Apiary A and a decrease in bees from Apiary B. Therefore, bees are not distributed at random in the area between apiaries, but, relative to the food supply, forage in greater numbers close to their hive. (Auth.)

78 Levin, M.D. DISTRIBUTION OF FORAGERS FROM HONEY BEE COLONIES PLACED IN THE MIDDLE OF A LARGE FIELD OF ALFALFA. J. econ. Ent. 54, 3 (1961) 431-4.

An experiment was conducted in northern Utah with colonies of honey bees (Apis mellifera L.) mass-marked for identification in the field. Cordovan strains were used for one group and colonies in the 2nd group were tagged with P^{32}. The 1st group, placed in the centre of a large field of alfalfa in bloom, oriented mostly to the field on which they were placed, and retained their dispersion pattern over a 2-week period. The 2nd group, placed in the same location a week later, distributed its foragers in much the same way as the first group but showed a tendency to orient farther afield. (Auth.)

79 Lloyd-Jones, C.P., Smith, B.D. THE USE OF RADIOACTIVE PHOSPHORUS TO FOLLOW THE MOVEMENT OF THE BLACK CURRANT GALL MITE. Rep. agric. hort. Res. Sta. Bristol (1960) 133-4. Long Ashton (1961).

Attempts to label black-currant gall mites (Cecidophyopsis ribis (Westw.)) with P^{32} by standing shoots cut from infested black-currant bushes before bud-burst in a solution of P^{32}-labelled sodium dihydrogen phosphate were unsuccessful. However, when mites from galled buds were dissected 3 d after the radioactive solution had been injected into the buds by hypodermic syringe the mites were found to be radioactive. When labelled buds were attached to uninfested plants, the mites rapidly left them, but could not be detected after dispersal. Plant tissues were digested in nitric acid, the digest made up to a standard volume and its radioactivity determined. It could be shown that the mites tended to move upwards and to congregate in the leaf axils.

80* MacLeod, J., Donnelly, J. NATURAL FEATURES AND BLOWFLY MOVEMENT. J. Anim. Ecol. 29 (1960) 85-93.

P^{32}-labelled Lucilia caesar group and Calliphora erythrocephala blowflies released beside a 200-yd-wide river were recaptured in numbers on the far side. In 2 late-summer and autumn tests of the barrier effect of a deciduous wood belt 90 yds wide, Lucilia sericata, L. caesar and C. erythrocephala were recovered beyond the wood; C. vomitoria was recovered beyond a 50-yd wide stand of conifers. Estimates are given of the density in the test areas of some of the species concerned. The bearing of the observations on dispersal theory is briefly discussed. (Essentially auth. summary).

81 MacLeod, J., Donnelly, J. DISPERSAL AND INTERSPERSAL OF BLOWFLY POPULATIONS. J. Anim. Ecol. 32 (1963) 1-32.

Flies trapped in particular sections of the test area were identified and paint-marked, either in restraint bags or under chill coma; they were subsequently maintained in cages according to section. During the following 2 d flies were radioisotope-tagged by the addition of P^{32} to sucrose solution in their cages. Three experiments are described in which separately marked groups of blowflies were released at different points, and the degree and speed of interchanges assessed by trap recoveries over a period of days. Two types of flight were recognized in the flies dispersing from the initial concentration, viz. dispersal- and interspersal-flying. The dispersal, or exodus, flight from the centres is apparently uni-directional, and either fast or sustained, since considerable distances were covered in short intervals (e.g. 200 yd at 7 mph, or more). Interspersal-type, or random-direction flying, may involve less, or no, net displacement. It is also responsible for a high degree of intermingling of populations from separate major habitats.

82 Молчанова, В.А., Мартенс, Б.К., Каменкова, К.В. РАДИОМАРКИРОВКА НАСЕКОМЫХ ДЛЯ ИЗУЧЕНИЯ ИХ МИГРАЦИИ. Стр. 26-8 в сб. "Материалы Симпозиума по применению биофизики в области защиты растений". Л. 1961.

Molchanova, V.A., Martens, B.K., Kamenkova, K.V. RADIOMARKING OF INSECTS FOR STUDIES ON THEIR MIGRATION. p.26-8 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961.

Experiments were carried out in 1958-59 in the Kustanaĭ region of the Soviet Union on the use of radioisotopes for labelling the grain Noctuid [Hadena sordida (Bkh.)] and its parasites for studies on their migrations. A method of labelling was used that was not liable to damage the insects. Light-traps were employed to attract the moths, which became labelled by contact with an attractive radioactive solution. They then dispersed, and their movements were observed radiometrically. The parasites Cnephalia (Isomera) cinerascens (Rond.) and Lampronota nitida (Grav.) (Meniscus agnatus (Grav.)) were taken in traps containing a radioactive solution prepared as for the moths. Observations on the moths showed that, during the period of supplementary feeding and oviposition, they covered distances of 0.5 km in a short time. The males were more active than the females, the distances covered ranging up to 3 and 2 km, respectively. The use of P^{32} to label the parasites showed that L. nitida, which parasitizes the larvae, was the more adapted to the moth. The distances covered during the period of mass flight and supplementary feeding were 100-200 m. At the beginning of the period of ear-formation, the moth and parasite moved in large numbers to wild and cultivated grasses and then to early varieties of wheat. While searching for hosts in which to oviposit in wheat fields, the parasites covered distances reaching 700 m. The development of C. cinerascens is not synchronised with that of the moth, the adults emerging 2-3 months before hosts in a suitable stage become available in the first half of summer. The adults therefore migrate for considerable distances in search of supplementary hosts, and flights of 18-20 km were recorded. (RAE-A 51: 1963, 523)

83 Odum, E.P., Pontin, A.J. POPULATION DENSITY OF THE UNDERGROUND ANT, Lasius flavus, AS DETERMINED BY TAGGING WITH P^{32}. Ecology 42, 1 (1961) 186-8.

From 400 to 1000 ants in each of 8 colonies were tagged by dipping into a solution of P^{32} (about 1 μc/ml) and returned to the colonies uninjured. One to 6 d later samples of 100-400 ants were removed and tested for radioactivity with use of a scanning system. Density and variance were calculated from the marking-1 recapture data using the formulas of Bailey (1951). It was found that a good relationship existed between the number of queens produced by a colony and the density of workers. Since queen production was determined in all colonies of a study area, the regression equation was used to calculate worker density in untagged as well as tagged colonies. Individual colonies were estimated to contain from 2000 to 11 000 ants. Estimated density for the most favorable area where the competitive species L. niger was absent was 1130 workers/m^2 or a living biomass of 1.36 g/m^2; density for the entire 277 m^2 study area was estimated as 485 workers/m^2 or 0.6 g/m^2. (Auth.)

84* Ogata, K., Nagai, N., Koshimizu, N., Kato, M., Wada, A. RELEASE STUDIES ON THE DISPERSION OF THE HOUSE FLIES AND BLOW FLIES IN THE SUBURBAN AREA OF KAWASAKI CITY, JAPAN. Jap. J. sanit. Zool. 11, 4 (1960) 181-88. (In Japanese, with English summary).

In studies on the dispersion of Musca domestica vicina Macq. and Lucilia (Phaenicia) spp. conducted in the suburbs of Kawasaki city, Japan, in September and October 1959, adults were caught in nets, kept for about 24 h, during which they were given milk labelled with P^{32}, and then released in the evening, when it became too dark for them to migrate. Attempts to recapture them were made for 23 d in houses situated within a radius of about 1100 yards of the release point, by means of fly-tapes or -papers or in cage traps. As the numbers of catching devices were not the same at each collection site, the numbers of labelled flies recovered did not give a true representation of the pattern of dispersal. However, the results indicated that a large number of flies moved within a radius of about 330 ft from the release point. Labelled flies were recaptured only east and west of the release point, and dispersion is thought to have been strongly affected by the presence of a range of hills, some 65-100 ft in height, to the south of the release point, of rice-fields to the north of it, and of a highway running from east to west through it. (From auth. summary)

85 Orphanidis, P.S., Soultanopoulos, C.D., Karandeinos, M.G. PRELIMINARY EXPERIMENTS WITH RADIOACTIVE PHOSPHORUS (P^{32}) ON THE DISPERSION OF OLIVE FRUIT FLY ADULTS (Dacus oleae Gmel.). Ann. Inst. phytopath. Benaki 4, 2 (1962) 155-8.

See 86.

86 Orphanidis, P.S., Soultanopoulos, C.D., Karandeinos, M.G. ESSAI PRÉLIMINAIRE AVEC ^{32}P SUR LA DISPERSION DES ADULTES DU Dacus oleae Gmel. p. 101-3 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Le manque de données numériques sur la dispersion de la mouche de l'olive a amené à faire un essai préliminaire avec 2500 adultes élevés dans des cages et marqués, avant leur lâcher, au moyen d'une solution sucrée contenant 20 μc de ^{32}P par centimètre cube. Les mesures ultérieures ont montré une dispersion des adultes marqués jusqu'à une distance de 2 km du point de lâcher pendant les jours ensoleillés d'hiver, dits alcyoniens. (Auth.)

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87 Pelekassis, C.E.D., Mourikos, P.A., Bantzios, D.N. PRELIMINARY STUDIES ON THE FIELD MOVEMENT OF THE OLIVE FRUIT FLY [(Dacus oleae (Gmel.)] BY LABELLING A NATURAL POPULATION WITH RADIOACTIVE PHOSPHORUS (P^{32}). Ann. Inst. phytopath. Benaki 4, 2 (1962) 170-9.

See 86.

88 Pelekassis, C.E.D., Mourikos, P.A., Bantzios, D.N. PRELIMINARY STUDIES OF THE FIELD MOVEMENT OF THE OLIVE FRUIT FLY (Dacus oleae Gmel.) BY LABELLING A NATURAL POPULATION WITH RADIOACTIVE PHOSPHORUS (P^{32}). p.105-13 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Preliminary trials were conducted in 1961 in the olive-growing area at Rovies, Evvia, Greece, during the autumn when maximum adult fly activity usually occurs. The adult fly population was tagged by painting branches of 30 selected olive trees with bait solution ($H_3P^{32}O_4$ in HCl and hydrolysate protein, Staley No. 7). 500 McPhail traps (with 3% diammonium phosphate lure) were distributed at Rovies and in the adjacent areas (forest and olive groves) up to 10 km from the treated trees; 350 tagged flies were collected. Radioactivity ranged from 258 to 9549 cpm/fly against 8-21 cpm background. Maximum dispersal was 4300 m. A more or less continuous local movement of flies took place from the semi-mountainous grove to the adjacent plains or to the coastal olive groves from north to south. No actual long distance movement (migration) was observed. Pine woods appear to act as a barrier to the movement of adult flies.

89 Rakitin, A.A. THE USE OF RADIOISOTOPES IN THE MARKING OF Eurygaster integriceps Put. Ent. Rev. 42, 1 (1963) 20-4. Translation from Ent. Obozr. 42, 1 (1963) 39-48.

Insects were labelled by dipping into a solution of Co^{60} chloride (~ 0.37 μc per insect). A wetting agent, OP-7 (a mixture of monoalkyl and dialkyl phenol ethylene oxide) were added; 0.03 ml of radioactive solution remained on the outer body casing. Insects were released at pre-selected points in checker-board fashion. Radiometric equipment was suitably adapted in the laboratory. Population and distribution of insects could thus be determined. P^{32} was used for tagging larval stages to study vertical and horizontal migrations on wheat and wild cereal grasses, in relation to the stage of development. Horizontal and vertical migrations were a function of nymphal age. Vertical migration varied with temperature, horizontal with the stage of development. - Experiments were carried out with adult insects to determine flight direction when moving to hibernation quarters, over-wintering, the locations of reservations in the forest and the direction of the spring flight from the forest to the field. In 1956, 220 000 and 320 000 tagged insects were released in the forest. A dispersal of up to 15 km was noted. There was scarcely any migration of insects into young belts of forest. In August, when the fat content was high insects flew, actively, from 0.5 - 1 km/d.

90 Schneider, F. DISPERSAL AND MIGRATION. Annu. Rev. Ent. 7 (1962) 223-37.

Review article. Radioisotopes were employed in some of the studies mentioned but no particular emphasis is given.

91* Шура-Бура, Б.Л. К ВОПРОСУ ОБ ИЗУЧЕНИИ МИГРАЦИИ КОМНАТНЫХ МУХ ПРИ ПОМОЩИ РАДИОАКТИВНЫХ ИНДИКАТОРОВ. Стр. 12-22 в сб. "Чтения памяти Холодовского". М., Изд. АН СССР. 1952.

Shura-Bura, B.L. USE OF RADIOACTIVE TRACERS TO STUDY THE MIGRATION OF HOUSEFLIES. p.12-22 in "A. A. Kholodkovskii Memorial Lectures". Moscow, Izd. AN SSSR. 1952.

92* Шура-Бура, Б.Л. ОПЫТ ИЗУЧЕНИЯ МИГРАЦИИ МУХ СО СВАЛКИ МЕТОДОМ МЕЧЕНЫХ АТОМОВ. Гигиена и Санит. 9 (1955) 12-5.

Shura-Bura, B.L. EXPERIMENTAL INVESTIGATION OF THE MOVEMENT OF FLIES FROM A REFUSE HEAP BY THE LABELLED-ATOM METHOD. Gigiena i Sanit. 9 (1955) 12-15.

93 Shura-Bura, B.L., Sukhomlinova, O.I., Isarova, B.I. RADIOACTIVE TRACERS AS AN AID TO STUDYING THE ABILITY OF SYNANTHROPIC FLIES TO FLY OVER WATER OBSTACLES. Ent. Rev. 41, 1 (1962) 55-60. Translation from Ent. Obozr. 41, 1 (1962) 99-108.

In 1957 (summer), about 30% of all flies on the town rubbish dump were labelled by placing a P^{32}-labelled bait there. Subsequent capture and radiometric examination of 3214 flies captured at 13 points in the town on both sides of the river Volkhov revealed 120 radioactive specimens (3.7% of the total captured). The flies dispersed from the dump primarily in the direction of the poorly constructed part of the town across the river. The dump was one of the main breeding sites for flies in Volkhov. Migration was mainly by flight. The Volkhov, 400-500 m wide near the town, proved no obstacle to fly migration.

94 Soenen, A., Proost, M. de, Vanwetswinkel, G. USE OF RADIO-ISOTOPES IN BIOLOGICAL INVESTIGATION OF FRUIT PARASITES. Agricultura 8 (1960) 259-68.

Out of 800-900 beetles (Anthonomus pomorum L.) tagged with P^{32} by feeding, only 15 were located after 12 d. A migration of the beetles is indicated. (13 references). (J. Sci. Food Agric. 12, 6:1961, i-279)

95 Soria, F., Cline, J.F. ÉTUDE DU VAGABONDAGE DE Ceratitis capitata Wied. EN TUNISIE À L'AIDE DE RADIO-ISOTOPES. Ann. Inst. nat. Rech. agron., Tunisie 32 (1959*) 79-94.

Deux lâchers d'adultes de C. capitata marqués à l'aide du ^{32}P ont eu lieu dans les environs de Tunis en novembre 1960 et en juin 1961. Les cératites provenaient d'un élevage de laboratoire, artificiel et continu. Au cours du premier essai, destiné à mettre au point la méthode à utiliser, 70 mouches ont été reprises, dans des gobe-mouches appâtés au phosphate bi-ammonique, sur les 353 cératites mâles et femelles lâchées 3 j auparavant. La distance maximum observée au bout de cette courte période a été de 315 m. Pour le 2e essai, 280 gobe-mouches, dispersés dans un verger long d'un peu plus de 1 km, capturèrent 449 individus sur les 2200 mâles radioactifs qui y furent lâchés. Un mâle a parcouru 460 m en un peu plus d'une journée et 16 autres, se déplacant plus lentement sur la même distance, se firent prendre le 4e jour. Le plus grand déplacement observé fut effectué par 2 cératites: 610 m en 5 à 7 j. Indépendemment de la distance, le pouvoir de dispersion des cératites s'est révélé comme étant soumis à diverses influences; celles du vent, de l'espèce végétale supportant les gobe-mouches et du temps écoulé depuis le jour du lâcher font objet de diverses observations. (Auth.)

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* Compiler's note: Article submitted on 5 July 1961.

96 Soria, F. ÉTUDE DES POPULATIONS ET DE DISPERSION DE Ceratitis capitata Wied. (Dipt. Trypetidae) EN TUNISIE A L'AIDE DES RADIOISOTOPES. p.357-61 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

En complément des études écologiques déjà réalisées et des essais préliminaires sur la dispersion, une méthode d'étude des populations a été mise au point, en utilisant des mouches marquées au ^{32}P (1 mc $^{32}PO_4H_3$ pour 100 g d'eau sucrée à 10%) dans un type de boîte de lâcher qui permet de contaminer 100-200 mouches à la fois. La valeur de la méthode parait être confirmée par les résultats donnés par d'autres procédés classiques. L'estimation de population ainsi réalisée a montré qu'il pouvait y avoir de 2 à 9 mâles par hectare à la fin de l'hiver dans différentes plantations.

97 Strong, F.E., Bacon, O.G., Russell, J.R. FLIGHT HABITS OF THE ALFALFA SEED CHALCID, Bruchophagus roddi Guss. (Hymenoptera: Eurytomidae). Hilgardia 35, 1 (1963) 1-12.

Eurytoma (Bruchophagus) roddi (Guss.) is an important pest of lucerne grown for seed in the western United States, and information on its flight habits was sought. The following is virtually the authors' abstract of this account of the work. The flight habits of the Eurytomid were studied in natural field populations and by the use of reared insects labelled with P^{32} or S^{35}. A minimum temperature of 70°F and a minimum light intensity of 0.2 Langley (1 ly = 1 calorie/cm²/min) was found necessary for sustained flight. In a favourable food-plant area, the insects dispersed only a few hundred yards within a few days. Movement in a breeze of less than 5 miles/h was both upwind and downwind. In stronger winds, it was predominantly downwind. The data obtained suggest that when a food-plant area dries up or otherwise becomes unsuitable, the insects fly upwards, where they encounter the stronger winds, and rapidly leave the area. Labelled individuals were recovered 4100 ft downwind of a release point; others were observed to survive 16 d in the field. (RAE-A 52:1964, 187)

98 Süss, A., Weigand, G. UNTERSUCHUNGEN ÜBER DIE AUSBREITUNG MARKIERTER RÜSSELKÄFER. (Study on the dispersion of labelled weevils). Atompraxis 7 (1961) 326-7. (In German).

Apion virens Hbst. and A. seniculus Kirby, which attack clover, were labelled by shaking them by hand for 10 min in a carrier-free solution of P^{32}, of specific activity 1 mc/ml. The insects were dried on filter paper, and had an activity of 25000 to 30000 cpm. They were then released every 25 m. Following release on May 3, checks were made on May 6, 9, and 13. A distance of 1.85 - 2.67 m was covered by 4 beetles, 7.03 and 7.43 m by 2, and 13.25 m by 1 (i.e. 3 "groups"), the speed of migration increasing after May 9 for the last 2. Direction of migration, total distance covered and final distance from starting point are discussed.

99 Ternovoí, V.I. A STUDY OF THE MIGRATION OF *Wohlfartia* FLIES BY THE METHOD OF RADIO-LABELLING. p.31 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961. (In Russian).

Wohlfartia magnifica (Schin.), which infests wounds on domestic animals, is widely distributed in the south of the Soviet Union. The movements of the adults were studied in 1959 by feeding them for 24 h on a sugar solution containing P^{32}, which they were shown, by radiometry and radioautography, to retain for at least 20 d. They were released in the field and recaptured near sheep pens either by a net or by traps baited with meat treated with a 0.02% solution of trichlorphon (chlorofos). Over 1000 were released, and 11 were recaptured, together with 59 unlabelled individuals, at distances ranging from 150 to over 2000 yd from the release point; some were taken near a pound that served as a watering-place for the sheep. Laboratory and field tests indicated that the labelled females transmitted radioactivity to their larval offspring. (RAE-B 51:1963, 212)

100 Wharton, R.H., Seow, C.L., Ganapathipillai, A., Jabaratnam, G. HOUSE FLY POPULATIONS AND THEIR DISPERSION IN MALAYA WITH PARTICULAR REFERENCE TO THE FLY PROBLEM IN THE CAMERON HIGHLANDS. *Med. J. Malaya* *17*, 2 (1962) 115-31.

Houseflies in Malaya are comparatively scarce in comparison with many other hot countries but they constitute a serious problem on the highlands where they breed in enormous numbers in the coarse organic manures used to fertilize terraced vegetable gardens. Observations on housefly populations at several places on the lowlands and at Cameron Highlands confirmed that flies, mainly *Musca domestica vicina*, were more common on the highlands but that large numbers were sometimes present in markets in lowlands towns and villages. In a mark-release-recapture experiment houseflies and blowflies (*Chrysomyia* sp.) which were tagged with P^{32} dispersed rapidly from their breeding grounds on the lowlands but houseflies were caught up to 12 d after release in the vicinity of a market. In a 2nd experiment Cameron Highlands marked flies were found to disperse in large numbers for distances of 0.25 mile and in fairly large numbers up to 0.5 mile. Flies were also carried by lorries from vegetable loading points, many for distances of 3 miles and some for 6 miles. Adult flies were exposed to insecticide deposits of DDT, dieldrin, BHC, diazinon and malathion. Flies on the highlands were knocked down at a slower rate than those from the lowlands, and flies from both areas appeared to be resistant to the 3 chlorinated hydrocarbon insecticides.

101 Yerington, A.P., Warner, R.M. FLIGHT DISTANCES OF *Drosophila* DETERMINED WITH RADIOACTIVE PHOSPHORUS. *J. econ. Ent.* *54*, 3 (1961) 425-8.

The flight range of *Drosophila* spp. has become increasingly important to the vineyardist and fig grower of the San Joaquin Valley of California due to the increased intermixing of various other fruit and vegetable crops and their attendant cull disposal problem. *Drosophila* were tagged with P^{32} on fermenting fruit paste and released in the field. Several types of bait traps were used to recapture the insects. *D. melanogaster* Meig. was trapped at a distance of at least 4.4 miles upwind from the release point after 24 h. (Auth.)

See also:

48 L'abeille et la radioactivité. (Nordau, 1962)
53 Use of isotopes for investigating the behaviour and ecology of insect pests in some recent studies. (Quraishi, 1963)
56 The role of radionuclides in insect behavior studies. (Schmidt and Smith, 1963)
139 Autoradiography as a method of detecting tagged rodents and their ectoparasites in a study of migration problems. (Shura-Bura and Kharlamov, 1961)
450 Radioactive labelling of lepidopterous larvae; a method of estimating late larval and pupal mortality in the wild. (Cook and Kettlewell, 1960)
452 Rearing and isotopic labelling of *Fannia canicularis*. (Fay *et al.*, 1963)
457 The use of radioisotopes for labelling flies. (Mingo-Perez, 1958)
463 The survival of adults of the white pine weevil, *Pissodes strobi* (Peck), labelled with radioactive cobalt. (Sullivan, 1961)

766 The application of nuclear energy to agriculture. (Boroughs, 1962)
782 The effect of ionizing radiation on the biology and ecology of *Rhodnius prolixus*, the principal vector of *Schizotrypanum* (i.e. *Trypanosoma*) cruzi in Venezuela. (Gomez *et al.*, 1962)
1442 Failure to reduce an isolated blowfly population by the sterile males method. (Mac Leod and Donnelly, 1961)
1452 Possibilities of eradication of the Mediterranean fruit fly *Ceratiti capitata* Wied. from Central America by gamma-irradiated males. (Katuyar, 1962)
1455 Sterilization of the Mediterranean fruit fly and its application to fly eradication. (Katiyar and Valerio, 1963)
1456 The application of nuclear energy to agriculture. (Moh, 1963)
1570 Use of radioisotopes and radiation in the control of plant and animal insect pests. (Andreev *et al.*, 1963)
1580 Travaux de recherches utilisant les isotopes et les rayonnements nucléaires en entomologie appliquée en France et dans les pays associés. (Pesson, 1962)

I-A-4 INTER-RELATIONS

I-A-4-a INSECT ENVIRONMENT

I-A-4-a-i

Radioactive contaminated systems (including deliberate contamination and fallout). Food chains

102 Auerbach, S.I. TRANSFER OF FISSION PRODUCTS THROUGH PLANT TO INSECT FOOD CHAINS. (Abstr. ElA910). p.131-2 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Current work involves further sampling of plants and insects on White Oak Lake bed to meet 2 objectives: (1) to obtain reliable data on the herbivore-predator transfer of radionuclides, and (2) to detect changes in radionuclide distribution in the ecosystem which might have occurred since the last major sampling in 1958.

103 Auerbach, S.I. TERRESTRIAL AND FRESH-WATER ECOLOGY - RADIATION EFFECTS ON *Chironomus tentans*. (Abstr. ElC905). p.140 in "Research and Development in Progress Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

The larvae of *C. tentans* live in the radioactive sediments of White Oak Creek and the Clinch River. The larvae are exposed to ionizing radiation which is 20-1000 times that of the natural background. The frequency of chromosomal aberrations in salivary gland chromosomes is being compared in irradiated and non-irradiated populations to determine whether there is an effect of increased radiation levels on the genetic constitution of the natural population. Photographs of the chromosomes from a non-irradiated population were taken, to construct cytological maps. Besides facilitating the scoring of chromosomes, these maps are to be compared with the cytological maps of *C. tentans* from Europe, and used to establish the standard chromosomal arrangement for this area.

104 Ball, R.C., Hooper, F.F. TRANSLOCATION OF PHOSPHORUS IN A TROUT STREAM ECOSYSTEM. p.217-28 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.

To explore the movement of P in a cold-water stream P^{32} was added. The uptake of P^{32} by aquatic insects and their role in the ecosystem is discussed on p.224, 225, 226 and 228. The summers of 1958, 1959 and 1960 are considered. Concentration curves for consumer organisms within the ecosystem reflected both differences in metabolic turnover rates and food relationships. The gross shape of a concentration curve appears to be characteristic of the animal rather than of the environment. Actual maxima for a given species were more closely related to stream conditions. Curves were similar for closely related species even though living in different microhabitats (e.g. the mayfly *Ephemerella cornuta* and *E. needhami*). Smaller forms (*Simulium* sp. and *Ephemerella*) consistently showed higher concentrations than larger forms (*Hexagenia limbata*, *Nigronia* sp., *Pteronarcys*), concentration rising to a rapid peak. Many differences in slope cannot be explained by size differences (relative growth and metabolic turnover) only. Accumulation of P^{32} was much slower for large omnivorous stream insects and for predacious forms even though they were comparatively small.

105 Ball, R.C., Wojtalik, T.A., Hooper, F.F. FISHERIES: UPSTREAM DISPERSION OF RADIOPHOSPHORUS IN A MICHIGAN TROUT STREAM. p.57-64 in "Papers of the Michigan Academy of Science, Arts, and Letters, Vol.58". 1963. (1962 meeting).

Data on upstream dispersion were collected from an application of ca. 25 mc of P^{32} incorporated into cells of Escherichia coli strain 0111. A stonefly (Isoperlinae) had a significant activity at the 400-yard station 36 d after release, and the fishfly, Nigronia, at the 400- and 500-yard stations. Of 21 collections, 1 sample of mayfly and 2 samples of the caddis fly, Brachycentrus, had significant activity. Predacious species appeared to carry activity more consistently than other forms. Larvae of the snipefly, Atherix, nymphs of a stonefly, and the fishfly, Nigronia, had activity in a larger percentage of collections than other forms. Various data suggest that radioactivity was taken up by invertebrates at or below the point of release and carried upstream by active migration as well as migratory flights of adults.

106 Ball, R.C. STUDY OF PRODUCTIVITY IN A STREAM ECOSYSTEM USING A RADIOACTIVE TRACER. (Abstr. E1C118). p.120-1 in Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963).

Findings have shown rapid uptake by diatom flora (producers) of the stream and transfer to filter-feeding organisms, Simulium, the primary consumers. The isotope is repeatedly recycled, through the producer plants and utilized by primary consumer groups in less time than it takes to reach the detritus feeders. Secondary consumers continue to increase in activity for at least 60 d in spite of the rapid physical transport within the stream. An upstream movement of P^{32} was brought about by the upstream migration of larval aquatic insects. The forthcoming project will make use of As^{74} incorporated in sodium arsenite (herbicide) to follow the pathways of arsenic through a pond ecosystem and establish its relationships to the several trophic levels within the pond and evaluate its potential hazard to man. (From abstr.)

107 Chauvin, R., Courtois, G., Anguenot, F. LES FOURMIS (Formica rufa) INDICATEURS POSSIBLES DES RETOMBÉES RADIOACTIVES. C.R. Acad. Sci., Paris 256,2 (1963) 508-11.

Le mécanisme par lequel les fourmis fixent les retombées, paraît en liaison directe avec leur habitude de prélever les excréments sucrés des pucerons des arbres, ou miellat. Les multiples gouttelettes gluantes ainsi exposées à l'air, doivent capter une très grande quantité de poussières atmosphériques et par conséquent, celles des retombées. Il est probable que la résine des conifères fixe aussi ces poussières, et que les fourmis en entraînent quelque peu au cours de leurs innombrables marches sur les troncs. D'autre part il y a toute indication que les fourmis ne défèquent pas à l'intérieur de la fourmilière. L'importance des fourmis comme détecteurs des retombées reste à évaluer du point de vue sensibilité et par rapport aux méthodes traditionelles. A l'examen γ spectrométrique les auteurs ont décelé dans les fourmis au cours des expériences des pics correspondants au ^{95}Zr, $^{95}(Zr{+}Nb)$, ^{141}Ce et ^{103}Ru.

108* Crossley, D.A., Jr. INSECT FAUNA OF WHITE OAK LAKE BED. "Health Physics Division Annual Progress Report for period ending 31 July 1957". ORNL-2384. 1957.

109* Crossley, D.A., Jr. WHITE OAK LAKE BED STUDIES/INSECT STUDIES. "Health Physics Division Annual Progress Report for Period Ending 31 July 1958". ORNL-2590. 1958.

110* Crossley, D.A., Jr. WHITE OAK LAKE BED STUDIES/INSECT STUDIES. "Health Physics Division Annual Progress Report for Period Ending 31 July 1959". ORNL-2806. 1959.

111* Crossley, D.A., Jr. INSECT STUDIES. "Health Physics Division Annual Progress Report for Period Ending 31 July 1960". ORNL-2994. 24 Oct. 1960.

112 Crossley, D.A., Jr., Howden, H.F. INSECT-VEGETATION RELATIONSHIPS IN AN AREA CONTAMINATED BY RADIOACTIVE WASTES. Ecology 42, 2 (1961) 302-17.

The development of insect populations on vegetation growing on White Oak Lake bed was followed for 3 years (1956 to 1958), immediately following the draining at White Oak Lake. This lake had served as a final holding basin for Oak Ridge National Laboratory's low-level wastes, and the alluvial terrain exposed upon drainage contained significant concentrations of radioisotopes, including Sr^{90} and Cs^{137}. The insect biomass, estimated by sweep-net and box-trap methods, was about 200 to 300 mg/m². No change could be demonstrated during the seasons, and evidently little change occurred between years. Significant concentrations of both Sr^{90} and Cs^{137} were found in samples of herbivorous insects. Concentrations of Sr^{90} were about 25%, and Cs^{137} concentrations about 1% of the soil values. However, the biomass of insects was minute compared to plant and soil masses, and the herbivorous insects contained but a minute fraction of the fission products in the system, since the bulk of these radioisotopes is in the soil. A sizeable fraction of the materials taken up by plants, however, may pass through the herbivorous insects in the system. Insect populations were followed in 2 areas each of smartweed, sedge-rush, and willow vegetation. Each of the vegetation types acquired its own characteristic insects. First-year insect populations tended to be dominated by one or a few species represented by many individuals. The 2nd-year populations showed a reduction in numbers for the dominant species and an influx of additional species, accompanying an increase in plant diversity. No such reduction of the dominant species occurred in the willow areas, presumably because the willows were increasing their coverage each year, and additional species of plants were not invading the willow stands. (Auth.)

113 Crossley, D.A., Jr., Corley, C.L., Tietjen, W.L. USE OF RADIOACTIVE TRACERS FOR ANALYSIS OF FOOD CHAINS. p.94-5 in "Health Physics Division Annual Progress Report for Period Ending 30 June 1963". ORNL-3492, Oak Ridge National Lab., Tenn. 30 Sep. 1963.

Use of biological elimination of radioisotopes in insects as indirect measures of metabolism under field conditions was continued with emphasis on the influence of temperature on elimination rates. In geometrid caterpillars the biological half life of Cs^{137} was decreased by one-half for a 10°C rise in temperature. Similar temperature-related trends were found for leaf beetles (Chrysomela knabi) and millipedes (Dixidesmus erasus).

114* Davis, J.J., Foster, R.F. BIOACCUMULATION OF RADIOISOTOPES THROUGH AQUATIC FOOD CHAINS. Ecology 39, 3 (1958) 530-45.

The relative concentrations of β-emitters in various Columbia river organisms were determined, amongst them those for caddis fly (Hydropsyche cockerelli Banks) larvae and mayfly (Ephemeroptera) nymphs. A graph shows the rate at which caddis fly larvae accumulated radioactive material, mostly P^{32}, when fed filamentous algae (mostly Spirogyra) that had been cultured in reactor effluent. The biological half-life was about 16 h. In a flowing stream, the specific activity of a radioisotope will diminish along the food chain. Thus, where the turnover rates of certain isotopes can be measured, inferences can be drawn on feeding habits.

115 Davis, J.J. ACCUMULATION OF RADIONUCLIDES BY AQUATIC INSECTS. HW-SA-2848, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 29 Nov. 1962. 13p.

A survey was made on the accumulation of radionuclides by aquatic insects in the section of the Columbia River that is within the Hanford Reservation in southeastern Washington. More than 60 different radioisotopes have been identified in the aqueous effluents that are continuously discharged into the Columbia River from some of the Hanford Reactors. About 20 of them have been measured in river organisms, among them Chironomid larvae (Hydrohaeninae and Tendipedinae), black fly larvae (Simuliidae), caddis fly larvae (Hydropsyche, Leptocella and Glossosoma), and aquatic moth larvae (Argyiactis). Insects living in the river below the reactor outfalls were found to be many times more radioactive than the water they inhabit. The most abundant radionuclides in insects were P^{32}, Cu^{64}, Cr^{51}, Zn^{65}, and Na^{24}. Interspecies differences in radionuclides accumulation are influenced by ecological and metabolic factors. The most important factors influencing radionuclide accumulation by different species were found to be food habits, biological half-lives of the elements, and seasonal variation in feeding. Typical accumulation factor patterns are presented for a number of immature and adult aquatic insects and also for plankton.

116 Hooper, F. ASPECTS OF BIOLOGICAL TRANSPORT OF PHOSPHORUS-32 IN STREAMS. p.247-55 in "Transport of Radionuclides in Fresh Water Systems. A Working Conference, Austin, Texas, 30 January - 1 February 1963". TID-7664, Johns Hopkins Univ. Baltimore, July 1963.

Amongst the aspects considered is the significance of the activity curve for different organisms. Such curves were plotted for a caddis, 2 fish, a mayfly, a fishfly, and filter feeders that live on the rock. The activity curve was characteristic of the species. The movement of this pulse of activity and its possible reflection of the food chain is discussed.

117 Howden, H.F., Crossley, D.A., Jr. INSECT SPECIES ON VEGETATION OF THE WHITE OAK LAKE BED, OAK RIDGE, TENN. ORNL-3094, Oak Ridge National Lab., Tenn. 1961. 38p.

Studies on the insects inhabiting this area, which had received low-level radioactivite wastes from the Oak Ridge National Laboratory for 12 years prior to draining in 1955, revealed 401 species present during 1956 and 1957. Most numerous were members of the insect orders Hymenoptera, Diptera, and Coleoptera. In the summer of 1956, the first summer following drainage of the lake, there were relatively fewer species of insects represented by large numbers of individuals. In 1957, there were relatively more species but fewer individuals. By the end of 1957, only 2 years after the lake was drained, the vegetation supported a rich and varied insect fauna.

118* Krumholz, L.A. AN ECOLOGICAL SURVEY OF THE LIMNOLOGY OF WHITE OAK CREEK AND LAKE. ORO-587 (Vol. II), Tennessee Valley Authority, Norris, Tenn. Feb. 1954, 180p.

Insect fauna and insect radioactivity have been studied in detail over a period of time. Results are tabulated. Percentages of total radioactivity emitted by P^{32}, Sr^{89,90} and Cs^{137} were determined for Tendipes and Chaoborus by radiochemical analysis of samples of various invertebrates collected in 1952.

119* Krumholz, L.A. AN ECOLOGICAL SURVEY OF THE VERTEBRATE FAUNA OF WHITE OAK LAKE AND ENVIRONS. ORO-587 (Vol. III), Tennessee Valley Authority, Norris, Tenn. Feb. 1954, 208p.

The fish population of White Oak Lake, which receives radioactive waste material from the Oak Ridge National Laboratory, was studied and their food habits analyzed (p. 85-98). Samples of Tendipes collected from the lake ranged in radioactive content from 150-2770 cpm/g, whereas those of Chaoborus ranged from 540-1340 cpm/g. None of the samples of stomach contents were analyzed radiochemically. However, (July 1952–) analyses of samples of Chaoborus and Tendipes, which form part of the insect food intake of fish, revealed several radioelements in the following proportions, respectively: P^{32} – 95.0, 50.0; rare earths – 2.0, 6.0; radioactive Sr – 0.5, 6.6; Cs^{137} – 1.1, 3.3.

120* La Verne, L.C. MIDGE LARVAE AS INDICATORS OF RADIOACTIVE POLLUTION. Engng Bull. Purdue Ext. Ser. 106 (1960) 269-80.

The 4th instar larvae of Tendipes plumosus and T. decorus cannot be used as indicators of pollution due to P^{32} and Fe^{59} because of the low rate of uptake by the larvae as compared to the resulting activity of the hydrosol from the water. Even when the population of larvae/m^2 (259 larvae) is considered, the total activity of the biota is only about 19.5×10^{-5} μc/12.9 g. This is considerably less than that of hydrosol estimated to be near 150×10^{-4} μc/g. However, further study should be made of the earlier instars of these benthic forms. Considerable effort will be required to determine whether the 1st instar larvae are planktonic after hatching from the egg and for what period of time. Studies in this laboratory indicate there is a rapid uptake of radionuclides through the larval integument from tap water. Comparable studies regarding all phases of their biology will indicate whether the larvae are capable of assimilating and holding quantities of radionuclides similar to that of the mud. (CA 55: 1961, 27721g)

121 Morton, R.J., Ed. RADIATION EFFECTS ON BIOTA. p. 58-65 in "Status Report No. 1 on Clinch River Study". ORNL-3119. 1961.

The effects of chronic low-level radiation resulting from radioactive wastes on a natural population of Chironomus tentans was investigated by sensitive cytogenetic methods. Salivary glands from larvae originating from a specified site in the Clinch River were studied; approximately 29% of the 48 organisms carried some type of heterozygous inversion in one of the 3 large chromosomes. Implications and future projects are discussed.

122 Morton, R.J., Ed. RADIATION EFFECTS ON BIOTA – ESTIMATED RADIATION DOSE RECEIVED BY DIPTERA WITH LIFE STAGES IN BOTTOM SEDIMENTS. p. 71-8 in "Status Report No. 2 on Clinch River Study". ORNL-3202. 13 Apr. 1962.

The radiation from radionuclides sorbed on the river and creek bottom sediments in the environment of the larvae was 20 to 1000 times that of the natural background. A relatively high frequency of chromosomal aberrations was observed in the salivary gland chromosomes of Chironomus tentans Fabr. larvae collected from White Oak Creek and the Clinch River. While C. tentans normally has 4 pairs of chromosomes, individuals were found with 3 pairs.

123 Nelson, D.J., Early, R.C., Griffith, N.A. BIOLOGICAL MOVEMENT AND RESERVOIRS OF Sr^{90}. Health Physics Division Annual Progress Report for Period Ending June 30, 1963. p. 109 in ORNL-3492, Oak Ridge National Lab., Tenn. 30 Sep. 1963.

The transport of Sr^{90} from the Clinch River by emerging aquatic midges (Chironomidae) was compared with the accrual of Sr^{90} to the river from weapons-testing fallout. Larval development of the midges occurs in the contaminated river-bottom sediments. Emerging adults were caught in insect light traps operated on the river bank at dusk. Adults in one large, composite sample contained 8.76 times as much Sr^{90} [$(3.55 \pm 1.3) \times 10^{-6}$ μc per gram of dry weight] as did an equal quantity of river-bottom sediment from the same location. Studies elsewhere have shown that 10 g m^{-2} yr^{-1} may be contained in the emergent insect biomass. These emergent insects would transport $(3.55 \pm 1.13) \times 10^{-5}$ μc of Sr^{90}/m^2/year from the river bottom. The average increment of Sr^{90} from fallout in the United States between 1959 and 1960 was 4.2×10^{-3} curie/square mile (1.62×10^{-3} μc/m^2). Thus, fallout entering the river directly would add 45 times as much Sr^{90} as removed by emerging chironomids.

124 Nelson, D.J. ROLE OF BOTTOM ORGANISMS. p. 193-201 in "Transport of Radionuclides in Fresh Water Systems. A Working Conference, Austin, Texas, 30 January - 1 February 1963". TID-7664, Johns Hopkins Univ., Baltimore. July 1963.

Of the radioactive material present in sediment, only Sr^{90}, Cs^{137}, and rare earths were confirmed in the insects tested, presumably due to the size of the sample. The possible use of insects as monitors is discussed. (See 123). The dispersal of radioactivity by emerging aquatic insects was thus shown to be of minor importance.

125 Odum, E.P., Kuenzler, E.J. EXPERIMENTAL ISOLATION OF FOOD CHAINS IN AN OLD-FIELD ECOSYSTEM WITH THE USE OF PHOSPHORUS-32. p. 113-20 in "Radioecology. Proceedings of 1st National Symposium on Radioecology held at Colorado State University, Fort Collins, 10 - 15 September 1961". New York, Reinhold Publishing Corp. 1963.

Three dominant species of plants, Heterotheca subaxillaris, Rumex acetocella, and Sorghum halepense in an oldfield ecosystem at the U.S. Atomic Energy Commission's Savannah River Plant were labelled by foliar application of P^{32} in separate 100-m quadrats in May 1957, and the subsequent amounts and distribution of tracer in animal populations were determined. When the concentration of the tracer per unit of biomass (mg of wet weight) was plotted against time, a clear graphic separation of certain trophic and habitat groups was evident in all three quadrats. The maximum concentration of P^{32} in major populations occurred as follows: Dorymyrmex, most common ant, and Oecanthus, most common known herbivore, 1-2 weeks; grazing herbivores in general, 2-3 weeks; sedentary spiders, 3-4 weeks; Cryptozoa (ground beetles, crickets, etc.), 4-5 weeks. The trophic position of 2 of the most common species, whose exact food source in nature was previously unknown, was rather clearly established by comparison of their uptake curves with those of species whose food was known. In general, the most common grazing herbivores such as the several orthopteran species fed freely on all 3 species of dominant plants, without marked preference, while some less common species were more selective. (From auth.)

126* Передельский, А.А., Богатырев, И.О. РАССЕИВАНИЕ РАДИОИЗОТОПОВ ВОДНЫМИ НАСЕКОМЫМИ. (Реферат доклада). Бюлл. Моск. Общ. Испыт. Прир., Отд. биол. 64, 2 (1959) 150.

Peredel'skiĭ, A.A., Bogatyrev, I.O. THE SCATTERING OF RADIOISOTOPES BY AQUATIC INSECTS. (Abstr.). Byull. mosk. Obshch. Ispyt. Prir., Otd. biol. 64, 2 (1959) 150.

127* Peredel'skiĭ, A.A., Bogatyrev, I.O. RADIOACTIVE CONTAMINATION OF LAND AREAS BY INSECTS EMERGING FROM CONTAMINATED WATER BODIES. Izv. Akad. Nauk SSSR, Ser. biol. 2 (1959) 186-92. (In Russian). English Translation: JPRS-17812.

Adult winged insect whose larvae have lived at the bottom of water bodies contaminated with radioactive isotopes contain small quantities of radioactivity in their bodies. A quantitative species-specificity was found for various isotopes (Cs^{137}, Sr^{90}, Co^{60}, undiluted mixture of β- and γ-emitters: fission products of a nuclear reactor) and insect species (caddis flies: chiefly Polycentropus flavomaculatus; mayflies Cloeon dipterum, Ephemerella ignita; and midges: chiefly Tendipes) investigated. Increasing specific activity of the water increased the radioactivity of the adult insect. A greater total activity is characteristic of the larger form of insect. The total activity removed from the water body by winged insects can reach high figures over a number of generations, of which each one consists of tens and hundreds of millions of individuals. The accumulation of radioactive insects in adjacent areas and the effective rate of bio-radioecological purification of such water bodies raises extremely grave issues.

128* Timofeev-Resovskiĭ, N.V., Timofeeva-Resovskaya, E.A., Milyutina, G.A., Getsova, A.B. ACCUMULATION COEFFICIENTS OF RADIOACTIVE ISOTOPES OF SIXTEEN ELEMENTS BY FRESH-WATER ORGANISMS AND THE EFFECT OF THE COMPLEX-FORMER ETHYLENEDIAMINE-TETRAACETATE (EDTA), ON SOME OF THEM. *Dokl. Akad. Nauk SSSR 132* (1960) 1191-4. (In Russian).

The following concentration coefficients (ratio of concentration of isotope in the organism to its concentration in the medium) were determined for the indicated radioelements: P^{32} 19 species of water plants 1430, 17 species of aquatic organisms (various animals included) 2470; S^{35} 90, 15; Ca^{45} 330, -; Fe^{59} 6860, 510; Co^{60} 4590, 2050; Zn^{65} 7240, 830; Ge^{71} 350, 70; Rb^{86} 950, 180; Sr^{90} 535, 765; Y^{91} 6530, 1080; Zr^{95} 4925, 640; Nb^{95} 7315, 380; Ru^{106} 1800, 545; I^{131} 370, 20; Cs^{137} 520, 265; Ce^{144} 6730, 2045. EDTA lowered the coefficients of Fe, Co, Zn, Y, and Ce considerably; those of Ca, Zr, Nb, Ru, and I were lowered slightly; those of Rb, Sr, and Cs were raised; and others were unchanged. (CA 55: 1961, 36796)

129 Тимофеева-Ресовская, Е.А., Тимофеев-Ресовский, Н.В., Гилева, Э.А. О СПЕЦИФИЧЕСКИХ НАКОПИТЕЛЯХ ОТДЕЛЬНЫХ РАДИОИЗОТОПОВ В СРЕДЕ ПРЕСНОВОДНЫХ ОРГАНИЗМОВ. *Докл. АН СССР 140*, 6 (1961) 1437-40.

Timofeeva-Resovskaya, E.A., Timofeev-Resovskiĭ, N.V., Gileva, E.A. SPECIFIC ACCUMULATORS OF INDIVIDUAL RADIOISOTOPES IN FRESH-WATER ORGANISMS. *Dokl. Akad. Nauk SSSR 140*, 6 (1961) 1437-40.

Table of data on accumulation of P^{32}, S^{35}, Ca^{45}, Cr^{51}, Fe^{59}, Co^{60}, Zn^{65}, Ge^{71}, Rb^{86}, Sr^{90}, Y^{91}, Zr^{95}, Nb^{95}, Ru^{106}, Cd^{115}, I^{131}, Cs^{137}, Ce^{144}, and Hg^{209} is presented for a selection of the lower animals and algae and aquatic plants. P, Co, Sr, Y, I, Cs, and Ce are intensively accumulated by some of the animals and all but Ca, Ge, Rb, Nb, I, and Hg are accumulated by at least some of the aquatic plants. Some data were also obtained for the accumulation of radioisotopes (Co^{60}, Cs^{137}) by caddis flies (Trichoptera).

130 Timofeeva-Resovskaya, E.A. DISTRIBUTION OF RADIOISOTOPES IN BASIC COMPONENTS OF FRESH-WATER BODIES. *Trud. Inst. Biol., Akad Nauk SSSR Ural'sk. 30* (1963) 1-79. English Translation: JPRS-21816. 1963. 104p.

Results are reported from a series of studies on the distribution of radioactivity from 18 different radioisotopes in surface waters, sediments, and aquatic organisms. Emphasis was placed on the concentration of the various radioisotopes by freshwater organisms. The radioisotopes investigated included P^{32}, S^{35}, Cr^{51}, Fe^{59}, Co^{60}, Zn^{65}, Ge^{71}, Rb^{86}, Sr^{90}, Y^{91}, Zr^{95}, Nb^{95}, Ru^{106}, Cd^{115}, I^{131}, Cs^{137}, Ce^{144}, and Hg^{203}. The following insects were studied: larvae of *Culex pipiens pipiens* L., *Theobaldia alascensis* Ludl., *Halesus interpunctatus* Lett., *Leptocerus* sp., *Phryganea grandis* L., *Aeschna* sp., *Lestes* sp., *Eristalsis* sp. and *Tendipes* sp.

See also:

154 Accumulation and excretion of Cs^{137} by grasshoppers. (Crossley, 1958)
157 Movement and accumulation of radiostrontium and radiocesium in insects. (Crossley, 1963)
165 The accumulation of radioactive isotopes by certain aquatic insects. (Getsova and Volkova, 1962)
166 The problem of the excretion of radioactive isotopes by various aquatic invertebrates. (Getsova, 1961)
167 Accumulation and removal of Ruthenium-106, Cerium-144 and Promethium-147 by the fly *Halesus interpunctatus* Zett. (Getsova and Volkolva, 1962)
183 Contributions to the accumulation and excretion of radioactive isotopes of seven chemical elements in dragon fly larvae. (Volkova, 1963)
184 The build-up factor of the radioisotopes of some chemical elements in aquatic insects. (Volkova, 1963).
1388 Chromosomal aberrations in a natural population of *Chironomus tentans* exposed to chronic low-level environmental radiation.
1389 Population genetics and radiation effects studies on *Chironomus tentans*. Health Physics Division Annual Progress Report for Period Ending June 30, 1963. (Blaylock *et al.*, 1963)
1565 Terrestrial and freshwater radioecology. A selected bibliography. (Klement, 1962)
1566 Terrestrial and freshwater radioecology. A selected bibliography. (Klement and Schultz, 1963)

I-A-4-a-ii Soil (natural and chemically treated)

131 Merker, E. STUDIEN ÜBER UNMITTELBARE UND MITTELBARE VERHÄNGNISVOLLE WIRKUNGEN DER BESTANDESDÜNGUNG AUF WALDVERDERBER. (Studies of direct and indirect damaging effects of fertilizers on forest pests). *Anz. Schädlingsk. 35*, 9 (1962) 133-40. (In German, with English summary).

Insects depend on the physiological condition of the plants on which they feed. Heat and dryness increases the content of sugar, approximatly up to 50%, and other nutrients in the plants. During rainy seasons the proportion of sugar decreases. The osmotic evaluation can be used as indicator of the physiological condition of the plants. The high concentration of sugar stimulates the development of the insects, but they also thrive on plants with high turgor. Young larvae feed only on newly burst open, most turgescent needles and leaves. This is true of the larvae of *Liparis monacha*, *Lymantria dispar*, *Pristiphora abietina* and two *Dreyfusia* on the young needles of the silver fir. Radioactive fertilizers enter the plants and feeding insects. P^{34} is mainly found in the intestines, Ca^{45} is deposited more in the vasa malpighi. It is suggested that fertilizing may over-feed these organs. Observations demonstrate that the physiological condition of the plants in spring and summer has no decisive effect upon the insects. The direct damaging effect of the fertilizers on the larvae is more profound. The adsorbed fertilizers seriously disturb the metabolism of the insects. (From auth. summary)

132* Peredel'skiĭ, A.A., Bogatȳrev, I.O., Karavyanskiĭ, N.S. INFLUENCE OF EARTHWORMS (Lumbricidae) AND WIREWORMS (Elateridae) ON THE UPTAKE OF RADIOACTIVE ISOTOPES CALCIUM-45 AND STRONTIUM-90 BY PLANTS FROM THE SOIL. *Dokl. Akad. Nauk SSSR 134* (1960) 1450-2. (In Russian)

Maize (*I*) and bean (*II*) plants were grown in soil contaminated with the isotopes, in presence and absence of the animals. The isotopes were concentrated more in the leaves of *I* in presence of wireworms. Where the isotopes were originally confined to a lower layer of soil the accumulation in the leaves was significantly less than when the isotopes were evenly spread through the soil. The presence of either animal species reduced the uptake of isotopes by the roots of *I*. In the leaves of *II*, Sr^{90} accumulated strongly in the presence of earthworms. In the roots of *I* accumulation of Sr^{90} was markedly reduced by wireworms and earthworms, but in roots of *II* it was slightly increased by wireworms and much increased by earthworms. Ca^{45} in leaves of *I* and *II* was increased strongly by wireworms and weakly by earthworms. In roots of *I* accumulation of Ca^{45} is greatly repressed by both species; in roots of *II* the accumulation is strongly increased by wireworms, but unaffected by earthworms. The increased uptake of isotopes in presence of wireworms is probably linked with the damage caused by these animals to the subterranean portions of plants. (CA 55: 1961, 9581e).

133* Peredel'skiĭ, A.A., Shain, S.S., Karavyanskiĭ, N.S., Nikolaev, G.V. SCATTERING OF RADIOISOTOPES IN THE SOIL BY EARTHWORMS (Lumbricidae). *Dokl. Akad. Nauk SSSR 135* (1960) 185-8. (In Russian)

It was shown experimentally that in earthworms living in soil containing Ca^{45} and Sr^{90} the specific radioactivity of the worm rapidly reaches a maximum level which is maintained without much variation afterward; this level may be near that of the contaminated soil. The faeces of earthworms tend to have higher specific radioactivity than found in the soil. Sample calculations are made to estimate the length of time required for a complete spread of radioisotopes over a given volume of soil from one contaminated site by the earthworms. Wireworms (*Agriotes sputator*) are relatively ineffective in spreading radioisotopes by the above mechanism, but the presence of such worms stimulates the intake of radioisotopes by plant roots in the soil. (CA 55: 1961, 11685c)

I-A-4-b INSECT-MICROORGANISM

134 Henry, S.M. THE SIGNIFICANCE OF MICROORGANISMS IN THE NUTRITION OF INSECTS. Trans. N.Y. Acad. Sci. 24, 6 (1962) 676-83.

Review article. Studies not only on nutritional but also on other physiological and biochemical relationships between the insect and its associated microorganisms are clearly facilitated by the use of radioisotopes. An attempt (unpublished) is reported, made by the authors, to determine the essential amino acids in Blattella germanica (by the method used in Nature 182 : 1958, 1380 and J. Insect Physiol. 8: 1962, 97). Glucose-U-C^{14} (25 μc/g) was fed to 4th instar nymphs as a 2% solution with a vitamin mixture. Both xenic and aposymbiotic* cockroaches were used. Details of subsequent procedures are given. Results of radiometric analysis are tabulated. The xenic cockroach apparently synthesizes all the amino acids which, according to their level of radioactivity, fall into 2 groups. The quantities detected in xenic and aposymbiotic animals, respectively, differ markedly. The intracellular symbiotes of Blattella clearly have an important function as a significant source of amino acids for their hosts, and they undoubtedly synthesize several growth factors as well. Intestinal microorganisms here, as is many other insects, are apparently of little importance.

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* Freed of intra-cellular symbiotes but not intestinal bacteria.

135 Martoja, R. ASSIMILATION DE LA CELLULOSE ET MICROORGANISMES INTESTINAUX CHEZ Gryllus bimaculatus DE GEER (Insecte, Orthoptère, Grylloidea). Note. C.R. Acad. Sci., Paris 254, 16 (1962) 3040-2.

Des Grillons normaux, d'autres partiellement privés de leurs germes, et deux Acridoidea dépourvus de segment à bactéries (Locusta migratoria L., Schistocerca gregaria Forskal), tous adultes ont été traités à 20°C, de la façon suivante: on leur a fait ingérer des fragments aussi semblables que possible de cellulose marquée au ^{14}C et ensuite on a recherché les composés radioactifs dans les tissus. Les faits rapportés démontrent, chez un Gryllide, une possibilité d'assimilation de la cellulose, qui semble être en rapport avec la présence du segment intestinal à microorganismes. Ils permettent de situer des relations entre les germes et l'hôte sur le plan de la symbiose: les bactéries dégradent la cellulose dont les dérivés sont assimilables par l'hôte; inversement, ce dernier apporterait aux germes certains composés, parmi lesquels des composés soufrés ont pu être mis en évidence.

See also:

46 A study of termite feeding relationships, using radioisotopes. (McMahon, 1963)
230 The sulfur metabolism of insects, VI. Metabolism of the sulfur amino acids and related compounds in the German cockroach, Blattella germanica (L.). (Henry and Block, 1961)
232 Amino acid synthesis, a rumen-like effect of the intracellular symbionts of the German cockroach. (Henry and Block, 1962)
373 The role of intestinal symbionts in the sterol metabolism of Blatella germanica. (Clayton, 1960)

I-A-4-c INSECT-ANIMAL

(Including Parasite and Predator Relationships)

136 Clark, E.W., Glick, P.A. SOME PREDATORS AND SCAVENGERS FEEDING UPON PINK BOLLWORM MOTHS. J. econ. Ent. 54, 4 (1961) 815-6.

In order to label them with P^{32}, adults of Pectinophora gossypiella (Saund.) were fed on a carbohydrate solution containing radioactive phosphoric acid. They were then released. Traps with lights near the ultra-violet range (3000-4000Å) were used which also caught predators and scavengers, some of them radioactive through feeding on the moths. A list of them is given. Amonst the insects listed was the checkered beetle, Enoclerus quadrisignatus Say, variously reported as of some economic importance as a predator in the Coastal Bend area of Texas, at times causing at least a 20% reduction in the pink bollworm population in cotton blooms. Other radioactive insecta, the numbers captured being in brackets, were Achetidae: Acheta sp. (4) Carabidae: Anisotarsus nitidipennis Lec. (1) Selenophorus fatuus Lec. (1) Stenomorphus californicus (Men.) (1) Labiduridae: Labidura riparia (Pallas) (Shore earwig) (5) Staphylinidae: Lathrobium sp. (1) Philonthus alumnus Er. (2)

137 Dissanaike, A.S. THE USE OF RADIOISOTOPES IN THE STUDY OF HELMINTH LIFE CYCLES. p.323-38 in "Radioisotopes in Tropical Medicine, Proceedings of a Symposium, Bangkok, 12-16 December 1960". Vienna, International Atomic Energy Agency, 1962.

The infective larval stage of helminths can be "activated" or "labelled" with P^{32} and other suitable isotopes with a view to following them up in the vertebrate host tissues. Various methods have been employed, depending on the type of life cycle involved. Thus, larvae transmitted by invertebrate hosts have been labelled by allowing them to develop in the tissues of previously labelled vectors, e.g. Wuchereria bancrofti in Culex fatigans and Setaria digitata in Armigeres obturans. The different methods are described and their possible use in elucidating certain unknown details of the life cycles of helminths of human importance is discussed. A few preliminary observations on γ-emitting, longer-lived radioisotopes, such as Cs^{137} and I^{131}, are discussed.

138 Каменкова, К.В., Молчанова, В.А. ПРИМЕНЕНИЕ РАДИОАКТИВНОГО ИЗОТОПА ФОСФОРА ДЛЯ МАРКИРОВКИ ЗЕРНОВОЙ СОВКИ И ЕЕ ПАРАЗИТОВ. Стр.111-? в сб. "Вопросы экологии. По материалам четвертой экологической конференции", №11. 1962.

Kamenkova, K.V., Molchanova, V.A. USE OF THE RADIOSIOTOPE OF PHOSPHORUS FOR LABELLING GRAMINIVOROUS NOCTUIDAE AND THEIR PARASITES. p.111-? in "Proceedings of the Fourth Ecological Conference, Voprosȳ ekologiĭ, No.11, 1962".

139 Шура-Бура, Б.Л., Харламов, В.П. РАДИОАВТОГРАФИЯ КАК МЕТОД ВЫЯВЛЕНИЯ МЕЧЕНЫХ ГРЫЗУНОВ И ИХ ЭКТОПАРАЗИТОВ ПРИ ИЗУЧЕНИИ ВОПРОСОВ МИГРАЦИИ. Зоол. Ж. 40, 2 (1961) 258-63.

Shura-Bura, B.L., Kharlamov, V.P. AUTORADIOGRAPHY AS A METHOD OF DETECTING TAGGED RODENTS AND THEIR ECTOPARASITES IN A STUDY OF MIGRATION PROBLEMS. Zool. Zh. 40, 2 (1961) 258-63.

Sr^{89} was given to rats (Rattus norvegicus) with bait, and fleas (Xenopsylla cheopis and Ceratophyllus fasciatus) by allowing them to feed on white mice which had been labelled by subcutaneous injection of Sr^{89}. Photographic film or photosensitive ECG paper was used. Radioactivity of skeletal bones could be traced for at least 1.5 months in rats given 0.28 mc/g, in faeces for at least 2 months. Fleas fed on mice given 4 mc/g body weight remained radioactive for at least 2.5 months.

140 Свиридов, Г.Г. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ В ИЗУЧЕНИИ НЕКОТОРЫХ ВОПРОСОВ ЭКОЛОГИИ БЛОХ. СООБЩЕНИЕ 2. КОНТАКТ ЗВЕРЬКОВ И ИНТЕНСИВНОСТЬ ОБМЕНА ЭКТОПАРАЗИТАМИ В ПОПУЛЯЦИИ БОЛЬШОЙ ПЕСЧАНКИ. Зоол. Ж. 42, 6 (1963) 947-9.

Sviridov, G.G. APPLICATION OF RADIOACTIVE ISOTOPES TO THE STUDY OF SOME PROBLEMS OF FLEA ECOLOGY. II. THE CONTACT BETWEEN RODENTS AND THE DEGREE TO WHICH ECTOPARASITES ARE INTERCHANGED IN A POPULATION OF Rhombomys opimus. Zool. Zh. 42, 6 (1963) 947-9. English Translation: JPRS-20864.

R. opimus and fleas were rendered radioactive by means of S^{35}-labelled methionine. Data are presented on the exchange of parasites, the intensity of infestation, and the range of fleas in a population of rodents (R. opimus) in burrows. The most intensive spread of labelled fleas took place in a radius up to 100 m from the place where they were released.

141 Свиридов, Г.Г., Морозова, И.В., Калуженова, З.П., Ильинская, В.Л. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ ПРИ ИЗУЧЕНИИ НЕКОТОРЫХ ВОПРОСОВ ЭКОЛОГИИ БЛОХ. СООБЩЕНИЕ 1. АЛИМЕНТАРНЫЕ СВЯЗИ БЛОХ Xenopsylla С БОЛЬШИМИ ПЕСЧАНКАМИ В ЕСТЕСТВЕННЫХ УСЛОВИЯХ. Зоол. Ж. 42, 4 (1963) 546-50.

Sviridov, G.G., Morozova, I.V., Kaluzhenova, Z.P., Il'inskaya, V.L. USE OF RADIOACTIVE ISOTOPES FOR THE STUDY OF CERTAIN PROBLEMS OF FLEA ECOLOGY. I. ALIMENTARY RELATIONS OF FLEAS OF THE Xenopsylla WITH Rhombomys opimus Pall. UNDER NATURAL CONDITIONS. Zool. Zh. 42, 4 (1963) 546-50.

Labelling of Rhombomys opimus with P^{32} and letting fleas of the genus Xenopsylla feed on them revealed that the alimentary activity of the fleas changed relative to the season. It varied in different structural areas of a burrow, due to the microclimatic conditions. In a flea population the females which have a higher feeding activity predominate, indicating their importance in the transmission of diseases. (From auth.)

See also:

32 Age characteristics involved in the feeding of Apanteles glomeratus L. larvae. (Shapiro and Khotyanovich, 1962)
33 Experiments on studying the feeding activity of fleas parasitizing Gerbillinae under natural conditions by means of radioisotopes. (Soldatkin et al., 1962)
55 The location of the nests of carpenter ants (Camponotus spp., Hymenoptera-Formicidae) by means of a radioactive isotope. (Riordan, 1960)
82 Radiomarking of insects for studies on their migration. (Molchanova et al., 1961)
158 Determination by radioactive iron (^{59}Fe) of the amount of blood ingested by insects. (De Freitas and Da Silveira Guedes, 1961)
159 Some data on the rate of iron elimination in Triatomids measured by radioactive iron (59Fe). (De Freitas and Campos, 1961)
160 Determinación de la cantidad de sangre ingerida por los insectos por medio del hierro radioactivo (^{59}Fe). (De Freitas and Da Silveira Guedes, 1962)
161 Algunos datos sobre la eliminación de hierro en triatomideos medida con hierro radiactivo (^{59}Fe). (De Freitas and Campos, 1963)
448 The use of radioactive isotopes for labelling ticks. (Babenko, 1960)
459 Use of radioactive carbon for the labelling of fleas. (Novokreshchenova et al., 1961)
586 Systemic action of two insecticides on arthropod parasites of rabbits and cattle. (Adkins, 1961)
570 Use of radioisotopes and radiation in the control of plant and animal insect pests. (Andreev, et al., 1963)

I-A-4-d INSECT-PLANT

(Including Forest Infestation)

142 Auerbach, S.I. ECOLOGICAL CYCLE OF Cs-137 IN A TULIP POPLAR FOREST. (Abstr. E1A899). p.129-30 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

To start the long-range experiments needed for following the redistribution of a tracer isotope in a forest ecosystem, the overstory of a 1/8 acre tulip poplar forest was tagged with 467 mc of Cs^{137} by inoculating 35 trees. Specific objectives and procedures considered for FY 1963 include trapping of foliage insects to relate their activity to that of their food supply, area-collection of insect frass, and measurement of isotope accumulation by invertebrate animals in leaf litter and soil.

143 Crossley, D.A., Jr. USE OF RADIOACTIVE TRACERS IN THE STUDY OF INSECT-PLANT RELATIONSHIPS. p.43-53 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

In both field and laboratory experimentation, insects are allowed to reach steady-state concentrations of radioisotopes through feeding. Then the rate of intake is equal to the rate of elimination of the radioisotope: (rate of ingestion) = (steady-state amount) x (fractional rate of loss). Measurements of elimination rates (biological half-lives) permit the steady-state concentrations to be translated into intake rate functions. Food consumption studies have been performed for single-insect-species populations and for multiple-species populations. In a single-species investigation, Cs^{137} in a tagged field site was used to estimate the consumption of willow leaves by populations of the beetle Chrysomela knabi. Direct measurements of food consumption made in the laboratory showed good agreement with field estimates of feeding rates based on the radioisotope techniques. Biological half-lives differed for the larval stages and these had to be considered separately. Radioisotopes provided a means of separating overwintering adults from newly emerged ones, through the more rapid elimination of caesium from overwintering adults. In multiple-species work, the relationship between size of insect and elimination rate was used to derive an average biological half-life for Cs^{137} elimination from herbivorous insects in a field site tagged with Cs^{137}. This average rate, used in conjunction with data on plant and insect biomasses and concentrations of radiocaesium, permitted an evaluation of plant consumption by an entire insect community. Similarly, the utilization of insects as food by predaceous arthropods was estimated from steady-state concentrations of radiocaesium in predators and prey, biomasses, and an average elimination rate. (From auth.)

144 Delattre, R. NOTE PRÉLIMINAIRE SUR L'UTILISATION DES RADIOISOTOPES DANS L'ÉTUDE DES PARASITES DU CONTONNIER EN AFRIQUE. p.85-92 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1962". Vienna, International Atomic Energy Agency. 1963.

Le chenille de Diparopsis watersi Roth est nuisible au contonnier en détruisant fleurs et capsules. Cette noctuelle, pratiquement monophage, passe l'inter-saison, soit dans le sol sous forme de chrysalides en diapause à partir du 10 novembre, soit par des générations continues (polyvoltines) sur les plants non arrachés. Des études de laboratoire ont permis d'élucider les principaux mécanismes déclenchant la diapause et y mettant fin. Des expériences préliminaires ont eu lieu à Tikem (République de Tchad) en vue de déterminer des techniques de marquage simples. Dans un premier essai, ^{32}P a été appliqué en pulvérisation aqueuse directe sur le feuillage de contonniers jeunes. Malgré la pluie, l'absorption fut de 10% environ par la plante en quelques heures. Diverses chenilles phyllophages (Sylepta derogata, Prodenia litura) ne retiennent pas de radioactivité, mais les chenilles qui se nourrissent d'organes fructifères (Heliothis armigera, Earias insulana, Diparopsis watersi, etc.) sont facilement détectable 3 mois après l'application. Dans un deuxième essai, ^{32}P et ^{35}S ont été appliqués sur des cotonniers âgés, juste avant la période de mise en diapause naturelle de Diparopsis. Les résultats d'ensemble laissent espérer que l'on pourra sans trop de difficultés distinguer, parmi les populations de chrysalides prélevées dans le sol, celles nourries sur le contonnier avant qu'il ne soit marqué, donc qui auront subi une diapause. Une contre-expérience sera ensuite nécessaire; elle consistera à marquer, en cours de saison, les cotonniers d'un champ ayant déjà porté la même culture l'année précédente, les chrysalides sans diapause étant cette fois marquées. Des observations annexes sont également en cours sur divers autres parasites du cotonnier. (From auth.)

See also:

14 Consumption of vegetation by insects. (Crossley, 1963)
24 Die Wirkung of Aphidenstichen auf pflanzliche Zellen. (Effects on plant cells of aphid punctures). (Marek, 1961)
59 Problems of practical importance in honeydew research. (Kloft, 1963)

I-A-4-e POLLINATION

See:

76 Méthodes d'études sur la dynamique des populations d'insectes, 1962. Méthodes d'étude des populations d'insectes pollinisateurs. (Rés.). (Lecomte, 1962)
75 Techniques d'étude des populations d'insectes pollinisateurs. (Lecomte, 1962)

I-B Insect Physiology and Biochemistry

I-B-1 GENERAL ARTICLES. SURVEYS

145* Андреев, С.В., Мартенс, Б.К., Молчанова, В.А., Шкарлат, Г.М. ИЗУЧЕНИЕ БИОЛОГИИ МАССОВОГО ВРЕДИТЕЛЯ ХЛЕБОВ...............МЕТОДОМ РАДИОМАРКИРОВКИ. Стр.107 в сб. "Тезисы докладов Научной конференции по применению радиоактивных и стабильных изотопов и излучений в сельском хозяйстве". М., Всесоюз. Акад. с.-х. Наук им. Ленина. 1958.

Andreev, S.V., Martens, B.K., Molchanova, V.A., Shkarlat, G.M. USE OF THE RADIO-LABELLING METHOD TO INVESTIGATE THE BIOLOGY OF ECONOMICALLY IMPORTANT GRAIN PESTS. p.107 in "Papers presented to the Scientific Conference on the Use of Radioactive and Stable Isotopes and Radiation in Agriculture". Moscow, Lenin All-Union Academy of Agricultural Science, 1958.

146 Beament, J.W.L., Treherne, J.E., Wigglesworth, V.B., Eds. "Advances in Insect Physiology. Vol.I". New York, Academic Press. 512p. 1963.

See 7, 427, 429

147 Gilmour, D., Ed. THE BIOCHEMISTRY OF INSECTS. New York, Academic Press. 1961. 343p.

The book aims at giving a complete and critical coverage of the field to date (1961). It is divided into a section on energy metabolism (nutrition, digestion, anaerobic energy production, aerobic energy production, energy conservation and conversion, and end products of catabolism), one on intermediate metabolism (of carbohydrates, lipids, and nitrogen compounds), and one on the biochemistry of development (hormones and morphogenesis in insects). Incidental mention is made of results obtained by radioisotope techniques.

148 Glascock, R.F. SOME EXAMPLES OF THE USE OF RADIOISOTOPES IN BIOCHEMISTRY. p.49-76 in "Use of Radioisotopes in Animal Biology and the Medical Sciences. Proceedings of a Conference, Mexico City, 21 November - 1 December 1961". Vol.I. London, Academic Press 1962.

Review article. One of the 8 topics covered deals with the labelled pool technique, with special mention of the work of Winteringham et al. published between 1955 and 1958 (p.61-2).

149 Heller, J. BIOCHEMISTRY OF INSECTS. Preprint 106. "Vth International Congress of Biochemistry, Moscow 10-16 August 1961. Symposium No.III". 9p.

The formation of pyrophosphate was investigated by injecting P^{32}-orthophosphate into pupae of the hawk moth, Celerio euphorbiae. The distribution of P^{32} in the reproductive organs of the male is shown autoradiographically and chromatographically. Pyrophosphate is removed from the active phase by way of complexing instead of splitting as occurs in other animals. Once formed, the pyrophosphate is stable and can be found in unmated males some years after death. The distribution of radioactivity in eggs, bursa, abdomen, thorax, and wings of a female Arctia caja mated with a male injected with 5 μC of P^{32}-orthophosphate is described. In C. euphorbiae, trehalose is absent from larval blood and appears only after onset of pupation, when it rapidly reaches its maximum concentration which is maintained until development of pupae into adults has started, accompanied by a rapid drop in trehalose content. A high content of non-sugar reducing substances is found in the blood. - Some generalizations concerning trehalose and ubiquinone are corrected. Uric acid synthesis in insects is shown to be no exception to the general pattern.

150 Kansu, A. BÖCEK FIZYOLOJISI VE BILHASSA TOKSIKOLOJISI ILE ILGILI ARAŞTIRMALARDA RADYOIZOTOPLARIN KULLANILMASI. (Radioisotopes in research on insect physiology and toxicology). Bitki Koruma Bült. 2, 9 (1961) 27-49. (In Turkish, with English summary).

Review article, touching on studies of DDT, BHC, organophosphorus insecticides, and fumigants.

151 Wyatt, G.R. BIOCHEMISTRY OF DIAPAUSE, DEVELOPMENT, AND INJURY IN SILKWORM PUPAE. p.23-41 in "Insect Physiology. Proceedings of the Twenty-Third Annual Biology Colloquium". Brookes, V.J. Ed. Corvallis, Oregon State University Press 1963.

Using ion-exchange chromatography adenine nucleotides and inorganic phosphate were measured in wing epithelium and fat-body of cecropia tissue following injection of $P^{32}O_4^{3-}$. In wing epidermis and fat body the adenosine triphosphate (ATP) rises at the beginning of development and remains high in diapause. The ATP adenosine diphosphate (ADP) ratios obtained by isotope dilution rise slightly at the beginning of development, while the adenine nucleotide concentrations in the epidermis are surprisingly low. The acid-soluble phosphates of fat-body were also low. Determinations of the incorporation of $P^{32}O_4^{3-}$ into ribonucleic acid (RNA) by fat-body tissue in vitro were made. Total RNA-P was measured after 6 h of incubation, and showed 3-fold greater concentration in tissues from early developing adults than in tissue from pupae in diapause. Experimental injury caused by cutting a 3-5 mm hole in the dorsal integument was studied. During 6 h after injury the incorporation of $P^{32}O_4^{3-}$ into RNA of wing epidermis increased. Carbohydrate metabolism was also measured after injury. Glucose, trehalose, and glycerol were isolated from haemolymph and fat body. Conversions of glucose to glycogen, glucose to trehalose, and glycogen to trehalose increased while that of glucose to CO_2, glucose to glycerol, and glycerol to trehalose were unaffected.

See also:

1575 Radyoizotoplarin entomoloji alaninda kullanilmasi. (Use of radioisotopes in entomology). (Kansu, 1963)

I-B-2 ELEMENTS. IONS. INORGANIC SALTS

152 Abdel-Malek, A.A., Abdel-Wahab, M.F. STUDIES ON THE PHOSPHORUS-32 UPTAKE IN Schistocerca gregaria (Forsk.) AND Anacridium aegyptium (L.). Bull. Soc. ent. Egypte 45 (1961) 419-25.

Adults of the species were tagged by feeding them with P^{32}-enriched bran mixture for 48 h. A comparative study of P^{32} uptake was made for the following organs: hind femora, wings, alimentary canal, genital organs, thoracic muscles, brain, and abdominal terga. Data were obtained at weekly intervals, the study continuing for 5 weeks. Greatest selctivity of P^{32} was found in the soft tissues (brain and genital organs). Colorimetric analysis agreed with radiometric results. The distribution of P^{32} in the different organs is given in 6 histograms.

153 Abdel-Malek, A.A., Abdel-Wahab, M.F. AUTORADIOGRAPHY AS A TECHNIQUE FOR RADIOACTIVE PHOSPHORUS, P-32, UPTAKE IN Culex molestus Forsk. Bull. Soc. ent. Egypte 45 (1961) 409-18.

A simple apposition method was used for estimating P^{32}-uptake at different developmental stages. It consisted of placing the insects on the unshielded side of a dental film for 1 h. The tin foil on the other side of the film increases the back-scatter of the β-rays emitted by the insect. From 0.025-5.0 μc/ml (in the form of $Na_2HP^{32}O_4$) were used per mosquito larva, and the P^{32}-uptake determination continued for 2 months. Densitometry was used on the films. Useful data were obtained for the range 0.05-2.0 μc/ml out of the 14 concentrations used. A P^{32} calibration curve was used. The technique lends itself particularly to estimating P^{32}-uptake in small insects where very small doses are used.

154* Crossley, D.A., Jr. ACCUMULATION AND EXCRETION OF Cs^{137} BY GRASSHOPPERS. "Health Physics Division Annual Progress Report for Period Ending 31 July 1958". ORNL-2806. 1958.

155* Crossley, D.A., Jr., Pryor, M.E. UPTAKE AND ELIMINATION OF CESIUM-137 BY A GRASSHOPPER - Romalea microptera. Hlth Phys. 4 (1960) 16-20.

Adult grasshoppers were fed Cs^{137} in bean plants to study uptake and elimination of the isotope. A biological half-life of 4-5 d was observed. The biological half-life was used to predict equilibrium values for grasshoppers allowed to feed repeatedly on Cs-contaminated food. The half-time for 50% accumulation would be about 4 d, and equilibrium would be approached after 5 such half-times. Most of the ingested Cs^{137} was concentrated in muscle tissue, and to a lesser extent in the digestive tract and the reproductive organs. Only trace amounts were found in the exoskeleton. (CA 55: 1961, 9696f)

156 Crossley, D.A., Jr., Schnell, J.H. COMPARATIVE ELIMINATION OF RADIOCESIUM AND RADIOSTRONTIUM BY GRASSHOPPERS. Ann. ent. Soc. Amer. 54, 2 (1961) 459-61.

A difference was found in the relative accumulation of Sr^{90} and Cs^{137} by insects at the White Oak Lake bed, a contaminated radioactive area at the Oak Ridge National Laboratory, Oak Ridge, Tenn. Insects reached Cs^{137} concentrations which were almost as high as concentrations in the plants, but Sr^{90} concentrations in the insects were nearly an order of magnitude lower than the corresponding plant concentrations. This difference was explained by results from laboratory studies with Sr^{85} and Cs^{137} in grasshoppers (Melanoplus differentialis) which showed that Sr^{85} was eliminated much more rapidly than Cs^{137}.

157 Crossley, D.A., Jr. MOVEMENT AND ACCUMULATION OF RADIOSTRONTIUM AND RADIOCESIUM IN INSECTS. p.103-5 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10 - 15 September 1961". New York, Reinhold Publishing Corp. 1963.

Studies of the insect inhabitants (grasshoppers, Conocephalus and Melanoplus; beetles, Systena; bees, mostly Lasioglossum; solder beetles, Chauliognathus; and some leaf-hoppers and aphids) of vegetation on the contaminated White Oak Lake measured the transfer of Sr^{90} and Cs^{137} from plants to insects, and evaluated the accumulation of the radionuclides by the trophic levels involved. Data on their accumulation by individual insect species showed that transfer of Cs^{137} from plant to insect tissue was more efficient than transfer of Sr^{90} (80% versus 10%). Differences seem due to the more rapid elimination of Sr by insects, with resulting lower equilibrium values. Per gram concentrations showed reductions in movement from soil to insects, with the major reduction occurring in the soil-to-plant step for Sr^{90}. The magnitude of such reductions is dependent upon the nature of the organisms involved. Transfer through trophic levels in this food chain (concentration per unit area) showed vast reductions at each step, due to the increasingly smaller masses of organisms involved in higher trophic levels.

158 De Freitas, J.R., Da Silveira Guedes, A. DETERMINATION BY RADIOACTIVE IRON (^{59}Fe) OF THE AMOUNT OF BLOOD INGESTED BY INSECTS. Bull. World Hlth Org. 25, 2 (1961) 271-3.

Three days after the injection into a fowl 4 months old of 1.5 ml solution of sterile iron citrate containing sufficient Fe^{59} to give 44.5 μc, the haemoglobin of the blood of the fowl already contained radioactive iron. Starved 5th-instar nymphs and adults of Triatoma infestans (Klug) and 1st-instar nymphs of Panstrongylus megistus (Burm.) were allowed to feed for 1 h on the labelled fowl, and females of Culex pipiens fatigans Wied. were given access to the bird overnight. The amount of blood ingested was calculated from the ratio of the radioactivity of the insect after feeding to that of 1 mm^3 of the blood, and the results were compared with those obtained when the insects were weighed before and after the blood-meal. With the Triatomines, results from both methods agreed when radioactivity was measured immediately after feeding. A few hours after the blood-meal, the Panstrongylus nymphs had eliminated 43% of the liquid ingested. The average amount of blood taken by Culex was found to be 3.3 mg by the gravimetric and 10.2 mm^3 by the isotopic method; about 70% of the liquid ingested was eliminated in < 12 h. The advantages of the Fe^{59} technique are a conveniently long half-life, a high degree of conversion to labelled haemoglobin, and persistence for several months in the blood of the vertebrate; and its easy detection, suitability for Fe-metabolism studies in several phases of insect life-cycle and the tracing of labelled insects.

159 De Freitas, J.R., Campos, M. SOME DATA ON THE RATE OF IRON ELIMINATION IN Triatomids MEASURED BY RADIOACTIVE IRON (59 Fe). Bull. World Hlth. Org. 25, 2 (1961) 274-6.

Studies on the elimination and assimilation of Fe^{59} by 5th-instar nymphs and adults of Triatoma infestans (Klug) and 1st-instar nymphs of Panstrongylus megistus (Burm.) are described. The bugs were allowed to feed overnight on the fowl with labelled blood, and the radioactivity of the insects and of their excreta was determined at intervals during the next 77-87 d, in the course of which the bugs were given two unlabelled feeds. The elimination of Fe^{59} was insignificant up to the 6th day after feeding. After 36 d, it was lowest in the 1st-instar nymphs and highest in the adults. At the end of the observations, the percentages of the ingested Fe^{59} assimilated by the 1st- and 5th-instar nymphs and the adults were 2, 19 and 5, respectively. The average retention time (the interval, in days, between the blood-meal and the time when 50% of the ingested Fe had been eliminated) was 40 d for the 1st-instar nymphs, 31 for the 5th-instar nymphs and 16 for the adults. Ways in which retention time may affect transmission of Trypanosoma cruzi by the Triatomines are suggested.

160 De Freitas, J.R., Da Silveira,Guedes, A. DETERMINACIÓN DE LA CANTIDAD DE SANGRE INGERIDA POR LOS INSECTOS POR MEDIO DEL HIERRO RADIACTIVO (^{59}Fe). Bol. Ofic. sanit. pan-amer. 53, 5 (1962) 426-9.

See 158.

161 De Freitas, J.R., Campos, M. ALGUNOS DATOS SOBRE LA ELIMINACIÓN DE HIERRO EN TRIATOMI-MEDIDA CON HIERRO RADIACTIVO (^{59}Fe). Bol. Ofic. sanit. pan-amer. 54, 1 (1963) 61-3.

See 159.

162* Faludi, B. Csukás-Szatlóczky, I., Széplaky, K. TRANSFER TO THE NEW GENERATION OF THE P^{32}, INCORPORATED BY THE PARENTS IN Drosophila melanogaster IMAGES. Ann. Univ. Budapest, Sect. Biol. 3 (1960) 171-8. (In English).

Organisms were grown at 26° on Belgowsky's medium containing P^{32} as inorganic phosphate. Under these conditions a generation develops in 200-40 h. Fractionations were obtained for 4-d old larvae, young pupae, and male and female imagoes. There was a marked increase in acid-soluble P just prior to the pupal stage. Beyond the pupal stage there was an increase in lipide P. Experiments on mating of radioactive adults with non-radioactive mates showed that the egg contributed 50 times as much P to the offspring as did the spermatozoa (calculation corrected for weight differences). The medium and the egg provided nearly the same amount of P to the alkali soluble and alcohol-soluble fractions of the larva. Spermatozoa and medium provided vastly different amounts of P to the various fractions, e.g. the sperm contributed much more P to the lipide fraction than did the medium. As expected, the P contribution of the medium to deoxyribonucleic acid was smaller than that of the spermatozoa. (CA 55: 1961, 19037g)

163 Faludi, B., Csukás, I., Széplaky, K., Dániel, F.A. TRANSMISSION OF PHOSPHORUS-32 INCORPORATED BY PARENTS INTO DESCENDANTS OF Drosophila melanogaster. Nature, Lond. 190 (1961) 469.

The quantity and distribution in seven phosphorus fractions of P^{32} incorporated into parents from the culture medium was followed in descendants of D. melanogaster strain Algeria, and tabulated. Intensive morphogenetical processes were seen to be preceded by a marked increase in the acid-soluble fraction, mainly at the expense of the alcohol-soluble one. From the pupal stage on an increase in lipoid phosphoru was observed. A significant drop in RNA content was found (see decreased protein synthesis). A pronounce increase in protein P was found in the imago. P^{32} distribution in the P fractions of the larvae originating from reciprocal crosses is tabulated. The quantity of P transmitted via the oöcyte is at least 50 times higher (not allowing for polyspermy!) than that transmitted by the male gametes. The distribution of P^{32} in the P fractions derived from the medium and gametes is also tabulated and clearly very different. Equal amounts of P^{32} are incorporated into the acid-soluble compounds of the alcohol-soluble fraction from both food and oöcyte but only traces are found if transmission takes place via the male germ cell. Other fractions are discussed.

164 Гецова, А.Б., Волкова, Г.А. О НАКОПЛЕНИИ И ВЫДЕЛЕНИИ СТРОНЦИЯ-90 И ЦЕЗИЯ-137 РУЧЕЙНИКОМ Halesus interpunctatus Zett. Докл. АН СССР 139, 2 (1961) 483-4.

Getsova, A.B., Volkova, G.A. THE ACCUMULATION AND ELIMINATION OF Sr^{90} AND Cs^{137} BY THE CADDIS FLY Halesus interpunctatus Zett. Dokl. Akad. Nauk SSSR 139, 2 (1961) 483-4.

Larvae of the caddis fly were placed in 5 l of water which had been contaminated with about 1000 cpm of Sr^{90} or Cs^{137}. After 3 and 6 h, 1, 4, and 8 d, a definite number of the insects were removed from the aquarium. Part of the insects were dried, weighed and counted in order to obtain the amount of Sr^{90} and Cs^{137} accumulated by the organism. The remainder of the insects were placed in clean water for 1, 4 and 14 d in order to determine the rate of decontamination. Activity determinations were made on both the cocoon and on the larva. The greatest amount of residual activity is left in both the cocoon and in the larva after an 8-d accumulation of activity as compared to a 3 or 6-h accumulation of activity. Most of the desorption of activity from the cocoon takes place during the first day. The contamination in the larva is removed more slowly and uniformly. (NSA 15: 28960, 1961)

165 Гецова, А.Б., Волкова, Г.А. О НАКОПЛЕНИИ РАДИОАКТИВНЫХ ИЗОТОПОВ НЕКОТОРЫМИ ВОДНЫМИ НАСЕКОМАМИ. Энт. Обозр. 41, 1 (1962) 109-24.

Getsova, A.B., Volkova, G.A. THE ACCUMULATION OF RADIOACTIVE ISOTOPES BY CERTAIN AQUATIC INSECTS. Ent. Rev. 41, 1 (1962) 61-70. (Trans. from Ent. obozr. for Scripta Technica, Inc.)

The concentration, accumulation factor and rate of desorption of various radioisotopes were determined for different stages of development of the mosquitoes Culex pipiens pipiens L. and Theobaldia alaskaensis Ludl., the caddis flies Halesus interpunctatus Zett., Phryganea grandis L., Leptocerus sp. and dragonflies of the genera Aeschna and Lestes. P^{32}, S^{35}, Ca^{45}, Cr^{51}, Fe^{59}, Co^{60}, Zn^{65}, Sr^{90}, Zr^{95}, Ru^{106}, Cd^{115}, Cs^{137}, Ce^{144}, and Hg^{203} were used. All experiments were performed in glass tanks containing lake water. Different species were found to accumulate a given element to different degrees, different elements accumulating to a different extent in a given species. Radioisotope accumulation varied according to the stage of development, the larval stages accumulating more radioisotope than the pupal stages. Adult insects remove considerable quantities of radioisotopes from water bodies and thus acquire great importance in the migration of radioactive substances. The accumulation of radioactive elements is a function of time. Their concentration in aquatic insects is conditioned by the activity level in the water: the higher the level, the higher the concentration in the insects. A rise in temperature causes increased accumulation by stimulating metabolism. The action of the EDTA biocomplexone is subject to general physical and chemical laws connected with the mineral exchange in living organisms. From the practical point of view, EDTA can be used for desorbing Ru^{106} and Ce^{144} from organisms and in biological deactivation of water from Sr^{90}.

166 Getsova, A.B. THE PROBLEM OF THE EXCRETION OF RADIOACTIVE ISOTOPES BY VARIOUS AQUATIC INVERTEBRATES.* Proc. Acad. Sci. USSR, biol. Sci. Sect. (Translation of Doklady Biological Sciences Sections) 133 (1961) 509-11.

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* An abstract of the original paper appeared in NSA in 1960, and was cited as ref. 267 in the preceding volume of this bibliography.

Experiments were carried out on, amongst others, the mosquito Culex pipiens pipiens L. and the caddis fly Halesus interpunctatus Zett. with Sr^{90}, Ru^{106}, Cs^{137} and Ce^{144} in trace amounts in water. The effects of adding EDTA (ethylene diamine tetra-acetate) to water were also studied. For Culex larvae Sr^{90} was excreted most slowly, in Halesus Cs^{137}. With or without ETDA rapid excretion of Sr^{90} and Ce^{137} occurred in insects after 2-4 d after which it became stabilized. ETDA facilitated excretion of radioisotopes by forming stable complex compounds except with Sr^{90}.

167 Гецова, А.Б., Волкова, Г.А. О НАКОПЛЕНИИ И ВЫВЕДЕНИИ РУТЕНИЯ-106, ЦЕРИЯ-144 И ПРОМЕТИЯ-147 РУЧЕЙНИКОМ. Докл. АН СССР 144, 5 (1962) 1163-4.

Getsova, A.B., Volkova, G.A. ACCUMULATION AND REMOVAL OF RUTHENIUM-106, CERIUM-144 AND PROMETHIUM-147 BY THE FLY Halesus interpunctatus Zett. Dokl. Akad. Nauk SSSR 144, 5 (1962) 1163-4.

Continuing previously publishing studies (Doklady Akad. Nauk SSSR, 133, 2 (1960); ibid., 139, 2 (1961)) on the desorption of radioactive materials from water insects, the removal of fission fragments from the fly Halesus interpunctatus Zett was investigated by means of the method described in the above-cited papers, taking into account the self-absorption of Pm^{147}. It was found that the residual activity of the insect depended on the length of their stay in the radioactive environment. From larvae, Pm was removed to the greater extent (residual activity 18%), followed by Ce (29%) and Ru (47%); from adult insects about half of the accumulated activity can be removed. Comparison with previous data on Sr and Cs indicated that there is a direct correlation between the period of accumulation and the removal of the radioisotope; Sr and Cs are removed to a greater extent from the adult specimens, Ru, Ce and Pm from the larvae. This is probably due to the ion-exchange type adsorption mechanism of Sr and Cs which can be washed off more easily from the surface of the adult insects. (NSA 16: 1962 (28709))

168 Grosch, D.S. DISTRIBUTION OF ZINC-65 IN THE WASP, Habrobracon, AND ITS EFFECTS ON REPRODUCTION. Nature, Lond. 195, 4839 (1962) 356-8.

Habrobracon juglandis (Bracon hebetor) were fed Zn^{65} (as sulphate not chloride) in sucrose water. In addition, wasps were reared on caterpillar hosts (Anagasta kühniella) injected with labelled zinc chloride. The radioactivity of whole animals, body parts and eggs were assessed. Egg production was consistently lower than control values after ingestion of 4 different doses of Zn^{65}. Results on egg hatchability are tabulated along with mean life-span. Exceptionally low hatchability occurred in eggs deposited on the 3rd day, those eggs also being the most highly radioactive. Localization studies showed differences in distribution according to the age at which radioactive feeding had occurred. Influence of Zn^{65} on egg production as well as shortened life and poor hatchability of eggs laid during senility seem due to zinc toxicity. Radiation from ingested Zn^{65} may influence hatchability of eggs during youth and middle age but except for the 3rd day results are not as impressive as with P^{32}.

169 Grosch, D.S. THE LOCALIZATION, PERSISTENCE AND RESULTANT GENETIC EFFECTS IN INVERTEBRATES OF INGESTED FOURTH PERIOD METALS IN STABLE AND RADIOACTIVE FORMS. (Abstr. B1B376) p.38 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

For the 1962-63 period we propose to continue research concerned with the tissues, cells and cell components with which fourth period cations become associated in the female insect. Along with these determinations, quantitative data on the sensitivity of ovarian cell types will be obtained from scoring egg production and embryonic survival. The special advantage of parthenogenetic production of male Habrobracon will be utilized in comparisons of impaternate offspring with survival of biparental offspring to determine induced dominant lethals. In addition to the stable isotopes employed, radiozinc, radiocobalt and radionickel will be fed. Radioactivity will be assessed for body parts and tissues and of the eggs deposited. Results will be correlated with hatchability records where possible and attempts will be made to distinguish between chemical damage and that for which radiation is responsible. Electrophoretic and chromatographic procedures will be applied in an attempt to determine the particular cell components which bind fourth period cations. Ingestion experiments with insects are of practical value not only because of the search for effective control measures but also because they yield fundamental information about the biological behavior of potentially hazardous nuclides of the environment. Unique features of a braconid wasp enables the investigator to distinguish between chromosomal and genic damage in the germ line, and interrelations with somatic tissue metabolism.

170* Heller, J., Chojnacki, T., Piechowska, M.J. PYROPHOSPHATE IN THE HAWK MOTH. Acta biochim. polon. 7 (1960) 187-92. (In English).

Pyrophosphate (I) accumulated in the ejaculatory duct of Celerio euphoribiae in a bound form (II) and could be detected only after acid or alkali treatment. The II was not hydrolyzed by crystalline pyrophosphatase (III) and III activity in the duct was negligible. The II was not dialyzable and gave no precipitate of Mn I with $MnCl_2$. To determine whether I occurred in some special form or whether III action was inhibited in some fashion, moths were injected with orthophosphate-P^{32}, which became incorporated into the I. This I was present as II which was not broken down by III although added non-labelled I was split. Injections of methionine-S^{35} became incorporated into proteins which also contained P^{32}. Data are given on accumulation of P^{32} in various organs after this isotope was injected. (CA 56; 1962, 5225e)

171 Huque, H. STUDIES ON THE PERSISTENCE, DECAY AND DISTRIBUTION OF RADIOPHOSPHORUS IN GRASSHOPPERS AND THE MADEIRA COCKROACH. p.155-9 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Three species of grasshoppers (Melanoplus differentialis, Melanoplus femur-rubrum, Dichomorpha viridis) and the Madeira cockroach (Leucophaea madeira) were labelled with P^{32} for persistence, decay, and distribution studies. Persistence of P^{32} was detected in measurable quantities beyond 30 d, while the biological half-life was found to range from 6.8 to 7 d in grasshoppers and 8.5 to 10 d in the Madeira roach. Radiophosphorus, when introduced into test insects in reasonable quantities, showed no toxic or detrimental effects on any stage of development of the insects. P^{32} was found in the cast skin and the oöthecae of the Madeira roach. Very small amounts of radioactivity were found in the egg capsules of the grasshoppers but not in their exuviae. The distribution of P^{32} in both insects (grasshoppers and the roach) was very similar after 48 h. The distribution study was also checked by autoradiography. Autoradiographs revealed greatest isotope concentration in the region of the hind gut and the metathoracic legs.

172 Lang, C.A. THE ACCUMULATION OF ZINC BY THE MOSQUITO (Aedes aegypti (Linn.), Culex pipiens (Linn.), Culex molestus (Forskal)). J. genet. Physiol. 46 (1963) 617-27.

Zn was determined by spectrographic and microchemical analysis and Zn^{65} was followed in the mosquito. Evidence for the specificity of Zn absorption was provided by several experiments using $Co^{60}Cl_2$ and Co^{60}-vitamin B_{12}. The Zn concentration was 5-10 times higher than other trace elements. Over 90% was localized in the Malpighian tubules. Concentration of Zn by the mosquito was much greater than by other insects. It is loosely bound, for it could be dissociated upon dialysis against ethylenediaminetetraaceticacid (EDTA). It was not found in egg masses, and once embodied by larvae was retained under fasting conditions beyond 14 d of adult life. EDTA in the media caused a marked inhibition of growth that could be reversed by addition of Zn.

173 Noble-Nesbitt, J. A SITE OF WATER AND IONIC EXCHANGE WITH THE MEDIUM IN Podura aquatica. J. exp. Biol. 40 (1963) 701-11.

Uptake of water occurs via the mouth and across the ventral tube vesicles. Drinking is important in water-stress situations and when the haemolymph pressure is low for eversion of the vesicles. Everted vesicles alone are sufficient for recovery from partial desiccation. Experiments in which insects with their mouths or ventral tubes blocked were exposed to a medium containing Na^{24} indicated that most of the exchange of Na between insect and medium occurs over the ventral tube vesicles, and that this exchange is rapid. With K^{43} no measurable exchange occurred between the insect and the medium. (CA 60: 1964, 12427g)

174 Odum, E.P. EXCRETION RATE OF RADIO-ISOTOPES AS INDICES OF METABOLIC RATES IN NATURE; BIOLOGICAL HALF-LIFE OF ZINC-65 IN RELATION TO TEMPERATURE, FOOD CONSUMPTION, GROWTH AND REPRODUCTION IN ARTHROPODS. (Abstr.). Biol. Bull. 121, 2 (1961) 371-2.

Laboratory experiments and a preliminary field experiment with two species of terrestrial insects (Tenebrio molitor and Oncopeltus fasciatus) and a marine isopod (Idothea baltica) indicate that the excretion rate of tracer amounts of Zn^{65} is proportional to certain activity rates, especially food consumption and egg production rates. Individuals were allowed to ingest contaminated food or water in a "tagging chamber", then transferred to a clean environment where the loss of radioactivity was followed by making periodic whole body counts in a well scintillation detector. Semi-log plots of radioactivity against time strongly indicated two pools of isotope: (1) a non-assimilated pool which is lost rapidly at a rate dependent on the level of the original "tag" and (in aquatic environments) on the physio-chemical nature of the environment, and (2) an assimilated pool which is distributed throughout the tissues of the body with some concentration in digestive organs and gonads and which is excreted much more slowly at a rate more directly related to metabolic processes. Biological half-life ($Tb_{\frac{1}{2}}$) of the assimilated pool varied from as long as 250 d in inactive adults kept at low temperatures to 20 d in active egg-laying *Oncopeltus* females or rapidly growing *Tenebrio* larvae. Young adult *Tenebrio* kept for 30 d at 10°, 20°, and 30°C averaged 163, 40, 23 d $Tb_{\frac{1}{2}}$, respectively, which is roughly inversely proportional to expected metabolic rate at these temperatures. $Tb_{\frac{1}{2}}$ of 5 adult *Oncopeltus* which had been confined to small bottles in the laboratory decreased 5-fold (125-25 d) when released for 10 d in an outdoor habitat, indicating much greater activity in the field. It is concluded that the rate of loss from the assimilated pool provides a "metabolic clock" for comparing laboratory and field rates of energy flow in arthropod populations.

175 Oftedal, P. STUDIES WITH RADIOACTIVE YTTRIUM IN FLIES. I. RETENTION AND DISTRIBUTION IN *Drosophila* AFTER INJECTION. *Int. J. Rad. Biol.* *3*, 2 (1961) 211-21.

After injection into *Drosophila melanogaster* males, Y^{91} citrate is completely retained. The pattern of distribution is shown to depend upon the injection site, and - with regard to the wings - upon the age of the fly at the time of injection. Microscopically, it is shown that two alternative patterns of distribution occur: The radioactivity is concentrated either in the pericardial cells and the thoracic nephrocytes, or in the haemocytes. The mechanism deciding which of these patterns will obtain is discussed. It is presumed that it depends upon the type of aggregate formed when the Y^{91} citrate is prepared from the solution of $Y^{91}Cl_3$. The findings are discussed, but no definitive explanation can be given. (Auth.)

176 Oftedal, P. STUDIES WITH RADIOACTIVE YTTRIUM IN FLIES. II. RETENTION AND DISTRIBUTION IN *Drosophila* AND IN *Musca* AFTER INGESTION. *Int. J. Rad. Biol.* *3*, 2 (1961) 222-30.

After ingestion, retention of Y^{91} citrate falls to a few per cent after 2-3 d in *Drosophila*, a week in *Musca.* This retained radioactivity forms a tail on the retention curve. The retention site in *Drosophila* - after 4 d - is shown to be a narrow band of cells in the endodermal mid-gut immediately anterior to the transition to the ectodermal hind-gut (pyloric region). In some flies, there is also a more diffuse and somewhat wider zone containing radioactivity in the middle mid-gut. There is no activity in the pericardial cells, or in the Malpighian tubules. In *Musca* - after a week - there is no activity in the pyloric region, but most of the activity is found in a region in the middle mid-gut. This zone is situated about one-third anteriad from the pyloric region, and covers 10-25% of the total mid-gut length. Also, the pericardial structures contain some 5-15% of the total activity. The findings are discussed. (Auth.)

177 Öktay, M., Sengün, A. INCORPORATION OF IRON-59 INTO THE CELLS OF DIFFERENT TISSUES OF *Chironomus plumosus.* *Nature*, Lond. *197*, 4867 (1963) 613-4.

Larvae of *C. plumosus* were exposed to tap water containing $Fe^{59}Cl_3$ solution (specific activity 100 mc Fe^{59}/g Fe. Differences in concentration and immersion period did not affect the result. Preparations were made from salivary glands, mid-gut, Malpighian tubules and rectum (squash preparations, stained with aceto-orcein, covered with Kodak Ar 10 stripping film and exposed 7-90 d. Great variability of localization in tissues and of association with cellular components makes results difficult to interpret (it is suggested that some Fe^{59} molucules are not bound to the chromosomes but are localized in the nucleoplasm). Similar results were obtained with *Drosophila melanogaster.*

178* Семенова, Л.М. ИЗУЧЕНИЕ ПРОНИЦАЕМОСТИ ПОКРОВОВ ПОЧВЕННЫХ НАСЕКОМЫХ ДЛЯ СОЛЕЙ МЕТОДОМ МЕЧЕНЫХ АТОМОВ НА ПРИМЕРЕ ЛИЧИНОК *Tipula paludosa.* *Зоол. Ж.* *36* (1957) 1826-30.

Semenova, L.M. STUDY OF THE PERMEABILITY OF THE INTEGUMENT OF SOIL INSECTS TO SALT BY THE METHOD OF TAGGED ATOMS, FOR EXAMPLE THE LARVAE OF *Tipula paludosa.* *Zool. Zh.* *36* (1957) 1826-30.

Solutions of $Na_2HP^{32}O_4$ and $K^{42}H_2PO_4$ were made in concentrations employed for fertilizers in hydroponics: 0.005, 0.025, 0.05, 0.1%. The K^{42} penetrated the larval cuticle in greater amounts than did P^{32}. The quantity of isotope permeating the cuticle was related to the concentration in the medium, but the rate of absorption was depressed by the higher concentrations of phosphate. The permeability of cuticle of these larvae was one-sided for the salts tested. (CA 52: 1958, 12247d)

179* Steffensen, D., LaChance, L.E. RADIOISOTOPES AND THE GENETIC MECHANISM: CYTOLOGY AND GENETICS OF DIVALENT METALS IN NUCLEI AND CHROMOSOMES. p.132-45 in "Symposium on Radioisotopes in the Biosphere". Minneapolis, Univ. of Minnesota. 1960.

Host caterpillars of *Ephestia kühniella* were injected orally with several concentrations of Ca^{45}. Virgin female *Habrobracon juglandis* were then allowed to oviposit on them. High concentrations of Ca^{45} were lethal to developing larvae. In some studies on metal deficiencies, Sr was found to be able to substitute to a certain degree for Ca and to prevent spontaneous chromosome breakage. The experiments have indicated that both Ca^{45} and Sr^{90} are incorporated into the sperm of *Habrobracon* and that the sperm nucleus retains both of these isotopes up to the fusion of the haploid male and female nuclei. As yet it has not been determined whether the isotopes are retained after DNA synthesis, that is, in the 1- and 2-cell embryo of *Habrobracon.*

180 Sutcliffe, D.W. STUDIES ON SALT AND WATER BALANCE IN CADDIS LARVAE (Trichoptera): I. OSMOTIC AND IONIC REGULATION OF BODY FLUIDS IN *Limnephilus affinis* Curtis. *J. exp. Biol.* *38* (1961) 501-9.

Larvae of *L. affinis* occur in both fresh- and brackish-water habitats in North West Europe. They were found to tolerate external salt concentrations up to at least 410 mM/l NaCl (~75% sea water) and survive for short periods in 460 mM/l NaCl (~85% sea water). The permeability of the body wall to Na ions was investigated by measuring Na^{24} influx from sea-water media. From these results the quantity of water imbided through the mouth could also be estimated. The technique is described in detail. Larvae were removed from radioactive media at > 100-h-intervals, and the radioactivity of a known volume (2-5 µl) of haemolymph was assessed. In each experiment the standard deviation of counts on 6-8 samples from one pipette was $< \pm 3\%$. Decay of Na, measured for various periods up to 60 h always resulted in a half-life of 15.1 h. The body wall is highly permeable to water, but relatively impermeable to Na and chloride. Most of the Na and chloride uptake from salt water occurs *via* the mouth. The Na and chloride levels in the haemolymph are powerfully regulated. Both are maintained strongly hypotonic against large external concentration gradients. The Malpighian tubule-rectal system is very sensitive to changes in the haemolymph chloride level. The chloride level in the rectal fluid can be at least 3 times higher than in haemolymph. The rectal fluid is hyperosmotic to the haemolymph and to the medium at high external salt concentration. At external concentrations > ~ 200 mM/l NaCl, water balance is maintained by regulating the haemolymph roughly iso-osmotic with the medium.

181 Sutcliffe, D.W. STUDIES ON SALT AND WATER BALANCE IN CADDIS LARVAE (Trichoptera). II. OSMOTIC AND IONIC REGULATION OF BODY FLUIDS IN *Limnephilus stigma* Curtis AND *Anabolia nervoso* Leach. *J. exp. Biol.* *38* (1961) 521-30.

Survival and regulation in sea-water media was studied in the fresh-water caddises *L. stigma* and *A. nervosa.* The majority of larvae did not survive for more than a few days at external salt concentrations > ~ 60 mM/l NaCl. In sea-water media the haemolymph osmotic pressure increased to remain slightly hyper-osmotic to the medium. The haemolymph Na level also increased to remain slightly hypertonic to the medium, but the chloride level was maintained hypotonic until just prior to death of the larvae. When the haemolymph chloride concentration was raised above the normal level, the Malpighian tubulerectal system elaborated fluid in which the chloride concentration was hypertonic to the haemolymph. The system is highly sensitive to changes in the haemolymph chloride level. The regulation of body-fluid composition in the fresh-water caddises is compared with that found previously in the euryhaline larvae of *L. affinis.* It is suggested that the maintentance of a low haemolymph Na concentration in *L. affinis* is an important part of adaptation for survival in salt water. Na^{24} was used. (Essentially auth. summary).

182 Sutcliffe, D.W. STUDIES ON SALT AND WATER BALANCE IN CADDIS LARVAE (Trichoptera). III. DRINKING AND EXCRETION. *J. exp. Biol.* *39* (1962) 141-60.

Na^{24} was used in these experiments. The fresh-water caddis larvae, *Limnephilus stigma* and *Anabolia nervosa,* drink and regurgitate large quantities of salt water at frequent intervals. Drinking is not controlled, and larvae may drink an amount equivalent to 50% of the body weight/d. The gut wall is adversely affected by salt water and exosmosis occurs across the gut wall. *L. affinis* larvae drink only small quantities of salt water. Drinking is strictly controlled, and the intake is roughly equivalent to 3-7% of the body weight/d over a wide range of external salt concentrations. The gut wall is not affected by high salt concentrations; regurgitation and exosmosis do not normally occur. In the fresh-water caddises the rate of rectal fluid production is approximately equivalent to 7% of the body weight/d. Rectal fluid is not produced at high external salt concentrations. *L. affinis* larvae continue to produce rectal fluid at very high external salt concentrations. The daily output is probably roughly equivalent to the daily intake of salt water by drinking. The osmoregulatory mechanism in L. affinis larvae and other salt-water insects is discussed. It is suggested that controlled drinking forms an important part of this mechanism, together with the ability of the gut wall to withstand exposure to high salt concentrations and the ability to elaborate rectal fluid hyper-osmotic to the external medium. (Auth. summary)

183 Волкова, Г.А. О НАКОПЛЕНИИ И ВЫВЕДЕНИИ РАДИОАКТИВНЫХ ИЗОТОПОВ СЕМИ ХИМИЧЕСКИХ ЭЛЕМЕНТОВ У ЛИЧИНОК СТРЕКОЗ. Зоол. Ж. 42, 1 (1963) 138-140.

Volkova, G.A. CONTRIBUTIONS TO THE ACCUMULATION AND EXCRETION OF RADIOACTIVE ISOTOPES OF SEVEN CHEMICAL ELEMENTS IN DRAGON FLY LARVAE. Zool. Zh. 42, 1 (1963) 138-40.

Experiments were performed on the accumulation and excretion of S^{35}, Co^{60}, Sr^{90}, Ru^{106}, Cs^{137} and Pm^{147} in the larvae of the dragon fly, Aeschna grandis L. The accumulation and excretion of the isotopes studied within the limits of the experiment depend on the chemical properties of the element and the period during which the insect remains in the radioactive medium. (From English summary).

184 Volkova, G.A. THE BUILD-UP FACTOR OF THE RADIOISOTOPES OF SOME CHEMICAL ELEMENTS IN AQUATIC INSECTS. Ent. Obozr. 42 (1963) 516-9. (In Russian). English Translation: JPRS-22034.

The build-up of P^{32}, S^{35}, Fe^{59}, Co^{60}, Zn^{65}, Sr^{90}, Y^{91}, Ru^{106}, Ag^{111}, I^{131}, Cs^{137}, Ce^{144}, Pm^{147}, and Hg^{203} by the larvae of certain aquatic insects was measured. The insect larvae were those of May flies (Cloeon dipterum), caddis-flies (Glyphotaelium punctatolineatus), dragon flies (Leucorrhinea rubicunda), and drone flies (Eristalis tenax). The build-up factors varied from one to thousands, depending on the element. Some variation among insects was also noted. Data are tabulated. (NSA 18: 1963, 3456)

185 Wlodawer, P. INCORPORATION OF P^{32} INTO THE PHOSPHOROUS COMPOUNDS OF THE WAX MOTH LARVAE. Acta biochim. polon. 8 (1961) 321-35. (English translation).

$Na_2HP^{32}O_4$ was sprayed on bee comb of which 200 mg was fed to full-grown Galleria mellonella larvae. After this was eaten, the larvae either were fed normally or starved. Larvae and excreta were analyzed and separated into various P fractions. The samples were evaporated in bakelite dishes and measured for radioactivity with an end-window GM counter (4 mg/sq cm). The P content of each fraction was determined. The P^{32} content of the acid-soluble P fraction, which was very high at the completion of the radioisotope ingestion, fell abruptly during the subsequent period of normal feeding. This was accompanied by an increase in the specific activities of the phospholipids and nucleic acids. The phospholipid specific activity reached its maximum 24 h after cessation of P^{32} ingestion and exceeded the activity of the acid-soluble P fraction. Almost all the P^{32} excreted by the larvae was found in polyphosphates. During starvation the fall in the specific activity of the acid-soluble P fraction was less pronounced than during feeding and the changes in the specific activities of the phospholipids and the nucleic acids were insignificant. Uniform labelling was found to occur in the acid-soluble P compounds of the starved, but not of the fed, larvae. (CA 56: 1962, 10720a)

See also:

14 Consumption of vegetation by insects. (Crossley, 1963)
29 The uptake of C^{14} and P^{32} from labelled leaves by two species of leafhopper vectors. (Orenski et al., 1962)
39 Quelques emplois des radioéléments et des rayonnements en entomologie. (Courtois and Lecomte, 1963)
46 A study of termite feeding relationships, using radioisotopes. (McMahon, 1963)

48 L'abeille et la radioactivité. (Nordau, 1962)
115 Accumulation of radionuclides by aquatic insects. (Davis, 1962)
123 Biological movement and reservoirs of Sr^{90}. (Nelson et al., 1963)
124 Role of bottom organisms. (Nelson, 1963)
128 Accumulation coefficients of radioactive isotopes of sixteen elements by fresh-water organisms and the effect of the complex-former ethylenediaminetetraacetate (EDTA), on some of them. (Timofeev-Resovskiĭ et al., 1960)
129 Specific accumulators of individual radioisotopes in fresh-water organisms. (Timofeeva-Resovskaya et al., 1961)

130 Distribution of radioisotopes in basic components of fresh-water bodies. (Timofeeva-Resovskaya, 1963)
133 Scattering of radioisotopes in the soil by earthworms (Lumbricidae). (Peredel'skiĭ et al., 1960)
143 Use of radioactive tracers in the study of insect-plant relationships. (Crossley, 1963)
149 Biochemistry of insects. (Heller, 1961)
210 Metabolism of the sulphur amino acids and of sulphate in Blattella germanica. (Block and Henry, 1961)
343 Structure and function of the giant chromosomes. (Sengün, 1962)
411 Radioisotopes and the insect central nervous system. (Treherne, 1962)
431 Sodium and potassium fluxes in the abdominal nerve cord of the cockroach. (Treherne, 1961)
432 Exchanges of sodium ions in the central nervous system of an insect (Periplaneta americana L.). (Treherne, 1961)
436 The distribution and exchange of some ions and molecules in the central nervous system of Periplaneta americana L. (Treherne, 1962)
437 Distribution of water and inorganic ions in the central nervous systems of an insect (Periplaneta americana L.). (Treherne, 1962)
441 Phosphate compounds in tissues of the cecropia silkmoth during diapause and development. (Garey and Wyatt, 1963)
460 Radioactive tracers as an aid to the measurement of energy flow at the population level in nature. (Odum and Golley, 1963)
491 Studies on the mechanism of aphid transmission of mosaic disease of Japanese radish using radioactive phosphorus 32. (Nishizawa et al., 1959)
1546 Technical problems of radioisotope measurement in insect metabolism. (Kloft, 1962)

I-B-3 CARBOHYDRATES

186 Agosin, M., Dinamarca, M.L., Scaramelli, N., Aravena, L. INTERMEDIARY CARBOHYDRATE METABOLISM IN Triatoma infestans. II. THE METABOLISM OF GLUCOSE-C^{14} IN T. infestans NYMPHS AND THE EFFECT OF DDT. Comp. Biochem. Physiol. 8 (1963) 311-20.

The metabolism of glucose-C^{14} uniformly labelled, or labelled in carbons 1, 2, or 6, as well as the levels of oxidized triphosphopyridine nucleotide (I) and oxidized diphosphopyridine nucleotide (II) kinase were studied in normal nymphs of T. infestans and those treated with DDT and DDE. With the exception of protein, the rates of C^{14} incorporation into CO_2, glycogen, and fatty acids from uniformly labelled glucose were higher in DDT-treated nymphs than in normal insects. The rates of $C^{14}O_2$ production from specifically labelled glucose and the rates of C^{14} incorporation into fatty acids from uniformly labelled glucose and glucose-6-C^{14} indicated that the reactions of the pentose phosphate are stimulated by DDT. This pathway accounted for 21.9% of glucose oxidation in normal insects and 77% in DDT-treated ones. DDE depressed somewhat this pathway. DDT increased the total contents of I but did not affect the ratios of I/reduced I. The effect of DDT on the levels of I appeared to be mediated through an increased synthesis of II kinase. These results supported the hypothesis that in T. infestans DDT is detoxified, at least in part, by a mechanism requiring reduced I. (CA 59: 1962, 2004h)

187 Bade, M.L., Wyatt, G.R. METABOLIC CONVERSIONS DURING PUPATION OF THE CECROPIA SILKWORM. 1. DEPOSITION AND UTILIZATION OF NUTRIENT RESERVES. Biochem. J. 83 (1962) 470-77.

Hyalophora cecropia silkworms, taken at intervals during the prepupal period, were analysed quantitatively to secure evidence on metabolic conversions. The loss of total dry weight falls within the limits calculated from the rate of respiration, assuming a non-protein respiratory quotient corresponding to catabolism of mixed carbohydrate and fat. Amounts of lipids decrease steadily during the prepupal period. Those of glycogen and free sugars decrease during spinning, then show an apparent increase about the time of the pupal moult. The amount of chitin, as well as total weight of cuticle, decreases sharply just before the moult. It is thus possible to account for the synthesis of glycogen and sugars by conversion of lipids. Larvae were injected with [1-C^{14}]glucose just before their 4th moult. By the end of instar V, the retained label was almost exclusively in the cuticle. Then, during the pupal moult, C^{14} was transferred to glycogen, sugars, and lipids. Chitin in the newly synthesized pupal cuticle has a high specific activity similar to that of the larval cuticle. Specific re-use of materials from the latter is suggested. (Auth. summary)

188 Bade, M.L. METABOLIC CONVERSIONS DURING PUPATION OF THE CECROPIA SILKWORM. 2. TESTS FOR THE OPERATION OF THE GLYOXYLATE CYCLE. Biochem. J. 83 (1962) 478-82.

The possible operation of the glyoxylate cycle in tissues of the pupating cecropia silkworm has been assayed by incubating the tissues with [2-C^{14}] acetate and comparing the incorporation of radioactivity in the presence of various substrates and of malonate into component acids of the citric acid cycle. There is a decrease of radioactivity in malate when glyoxylate is not an efficient remover of active acetate. Very little C^{14} is incorporated into malate in the presence of malonate, suggesting that the major route of malate synthesis is via the citric acid cycle. Tissues obtained from feeding larvae and early pupae show qualitatively the same incorporation pattern; enzymic activity/mg of protein diminishes greatly in the order: larva, prepupa, pupa. These results are consistent with the operation of the citric acid cycle as a major pathway of acetate metabolism in the stages of silkworm development investigated and fail to support appreciable activity by the glyoxylate-cycle enzymes in any of them. (Auth. summary)

189 Candy, D.J., Kilby, B.A. THE BIOSYNTHESIS OF TREHALOSE IN THE LOCUST FAT BODY. Biochem. J. 78 (1961) 531-6.

Generally labelled D-[C^{14}] glucose was used throughout the study. An extract prepared from the fat body of Schistocerca gregaria catalyses the formation of trehalose from glucose and uridine diphosphate glucose. Glucose 6-phosphate and trehalose phosphate were indicated as intermediates in this reaction. The extract hydrolyses trehalose phosphate at a greater rate than any other sugar phosphate tested. The presence was shown of phosphoglucomutase, nucleoside diphosphate-kinase and uridine diphosphoglucose-pyrophosphorylase activities in the fat body. A scheme for the biosynthesis of trehalose from glucose in the fat body of Schistocerca is presented. (Essentially auth. summary)

190 Clegg, J.S., Evans, D.R. BLOOD TREHALOSE AND FLIGHT METABOLISM IN THE BLOWFLY. Science 134 (1961) 54-5.

The concentration of trehalose in the blood of Phormia regina was found to determine the rate of energy expenditure during flight as reflected in measurements of the wing-beat frequency. Fat body was found to be the source of blood trehalose; either endogenous or exogenous substrates are used for its synthesis. Synthesis of trehalose by the fat body from exogenous glucose and its release into the medium was demonstrated by incubating intact fat body with glucose-U-C^{14} (specific activity 2620 cpm/µM). Trehalose isolated from the medium after 30 min of incubation had a specific activity of 822 cpm/µM, i.e. 93% of the total counts, other than glucose, found in the medium.

191 Clegg, J.S., Evans, D.R. THE PHYSIOLOGY OF BLOOD TREHALOSE AND ITS FUNCTION DURING FLIGHT IN THE BLOWFLY. J. exp. Biol. 38 (1961) 771-92.

The finding of earlier workers that glucose and trehalose are the normal blood sugars in Phormia regina was confirmed. Most of the flight energy is derived from the oxidation of trehalose and, to a lesser extent, of other sugars in the blood. The concentration of blood trehalose normally regulates the rate at which energy is expended by the flight muscles. Exhaustion results when trehalose cannot be supplied at the necessary rate. Fat body is the chief source of blood trehalose; endogenous and exogenous substrates are used for the synthesis. The rate of blood synthesis can be very rapid, almost compensating for the rate of utilization during flight. The intensity of flight is determined largely by the interaction of rate of trehalose utilization and that of trehalose synthesis. Blood volume was estimated from dilution of injected C^{14}-inulin to be 6-7 µl. (CA 58; 1963, 1750c)

192 Gordon, H.T., Robbins, D.A. METABOLISM OF GLUCOSE AND D-ARABINOSE IN THE GERMAN COCKROACH. (Abstr.80). Bull. ent. Soc. Amer. 9, 3 (1963) 164.

Male B. germanica oxidize injected D-glucose-U-C^{14} slowly and D-arabinose-1-C^{14} rapidly to expired CO_2, by independent pathways. Both sugars are cleared from the blood within 1 h but persist in tissues for many hours. Several metabolites of each sugar have been tentatively identified.

193 Hines, W.J.W., Smith, M.J.H. SOME ASPECTS OF INTERMEDIARY METABOLISM IN THE DESERT LOCUST (Schistocerca gregaria Forskal.). J. Insect Physiol. 9, 4 (1963) 463-8.

The incorporation and distribution of radioactivity from [C^{14}]glucose, [2-C^{14}] acetate, and [1:4-C^{14}_2] succinate into the soluble metabolic intermediates of homogenates of the fat-body, head, and leg muscle of S. gregaria have been studied. The tissue homogenates were found to utilize the labelled substrates, but the patterns of incorporation of the radioactivity from each substrate varied with the tissue. (Auth.)

194 Kubišta, V., Foustka, M. INORGANIC PHOSPHATE AND THE RATE OF GLYCOLYSIS IN INSECT MUSCLE. Nature, Lond. 195 (1962) 702-3.

Changes in the acid-soluble phosphorus compounds were followed during anaerobiosis and in subsequent recovery in O_2 in preparations of the intact metathoracic musculature of the cockroach Periplaneta americana. Phosphorus compounds were labelled by injecting P^{32} a week prior to the experiment, by which time practically uniform labelling of all soluble P compounds had been achieved. Evidence is presented to show that the level of inorganic phosphate is rate-limiting for anaerobic glycolysis in the tissue.

195* Lasker, R., Giese, A.C. CELLULOSE DIGESTION BY THE SILVERFISH, Ctenolepisma lineata. J. exp. Biol. 33, 3 (1956) 542-53.

Silverfish fed cellulose uniformly labelled with C^{14} respire $C^{14}O_2$. The insects may gain weight temporarily on a diet of cellulose alone but the diet is not satisfactory for prolonged feeding. Utilization efficiency for cellulose is comparable to that of the dairy cow. None of the bacteria from the guts, grown in favorable culture media, are capable of digesting cellulose. A few molds do, though they are never seen growing in the gut and are presumably developed from spores grazed from wood by the silverfish. Bacteria-free insects were obtained by washing eggs in a solution of $HgCl_2$ and EtOH and raising the nymphs on rolled oats and vitamins under aseptic conditions. These insects also respired $C^{14}O_2$ when fed labelled cellulose. A cellulase, cellobiase, and an amylase were present in extracts of the midgut. (CA 51: 1957, 3852a)

196 Lipke, H., Grainger, M. MUCOPOLYSACCHARIDES OF THE COCKROACH DURING MOLTING. (Abstr.) Fed. Proc. 21, 2 (1962) 170.

The principal bound carbohydrates of the plasma are mannose, galactose and glucosamine, with glucose, arabinose, xylose and galactosamine as lesser entities. During molting, characteristic changes in the protein and acid fuchsin-positive components of the plasma are evident (Siakotos, J. gen. Physiol. 43: 1960, 1015) which are accompanied by a redistribution of bound sugars into mannose-rich and galactosamine-rich glycoproteins. Mole ratios of bound carbohydrates vary throughout the entire molting cycle and continue after shedding of the old cuticle. Incorporation of glucose-U-C^{14} into plasma glycoprotein was measured essentially as described by Spiro (JBC 234: 1959, 742) before, during and after ecdysis. Between molts, amino acids of the protein moiety acquired the most label by a factor of 7 over the pre-molt period. Significant incorporation occurred in 24 h. Two-fold increases were observed in cpm/µM bound hexose during this period while hexosamine increased 5-fold. Amino sugars incorporation achieved a maximum rate considerably faster than neutral sugars. The rates of incorporation and composition of the protein-bound sugars of other tissues will be described.

197 Lipke, H., Graves, B., Leto, S. POLYSACCHARIDE AND GLYCOPROTEIN FORMATION IN THE COCKROACH. (Abstr. 2962). Fed. Proc. 22, 2 (1963) 656.

Cuticle freed of hypoderm contains 0.5% by weight of bound carbohydrate other than Gm, identified as Glu, Gal, Man, Ar, and Xyl. These sugars occur in all the strata, indicating a function other than connectives. During the molt cycle the rate C^{14} incorporation from injected Glu-C^{14} differs for each of the hexoses of the cuticles and for Gm and N-Ac of chitin. Autonomy of the integument with respect to synthesis of polysaccharide and glycoprotein is suggested since specific activity of bound carbohydrate and polypeptide exceeds that of corresponding plasma or fat body materials, and no pentose can be detected in fat body. The chitin N-Ac does not follow a product-precursor relation with lipid, specific activity is 1% of chitin Gm. Amino acid analysis of cuticle shows aspartic and tyrosine to be deficient in strata first formed, with label from Glu-C^{14} in all amino acids after 24 h.

198 Saito, S. TREHALOSE IN THE BODY FLUID OF THE SILKWORM, Bombyx mori L. J. Insect Physiol. 9, 4 (1963) 509-19.

The rate of metabolism of "blood sugar" (trehalose) was studied using 5th instar larvae of the silkworm, Bombyx mori. Glycogen in the fat body decreased on starvation while body fluid trehalose remained approximately at the initial value during the first few hours of starvation. Experiments on the rate of turnover of body fluid trehalose were carried out by injecting radioactive sugars into the larvae. Values of 6 h and 10.6 h were obtained for the half-life of body fluid trehalose under feeding and starvation, respectively. When a large volume of saline was injected into starved larvae, the concentration of "blood sugar" fell temporarily, and after a while it regained its initial level. On the other hand, when a large amount of trehalose was injected, the level of "blood sugar" was elevated markedly followed by a fall to a value somewhat higher than the initial. These results suggest the existence of a homeostasis in blood sugar level. Mechanisms responsible for such a homeostasis are discussed. (Auth.)

199* Silva, G.M., Wang, C.H., Doyle, W.P. GLUCOSE CATABOLISM IN THE DDT TREATED AMERICAN COCKROACH (Periplaneta americana L.). Arquit. portug. Bioquim. 3 (1958) 297-304. (In English).

By using C^{14}-labelled glucose it had already been shown that 9% and 91% of the injected substance was catabolized by way of the phosphogluconate decarboxylation and the Embden-Meyerhof-Parnas glycolytic pathways, respectively (cf. Nature 182: 1958, 102). The method used consisted of injecting known quantities of metabolites, labelled with C^{14} at the same atom, placing groups of treated insects in special chambers, and collecting the expired $C^{14}O_2$. By means of appropriate calculations it was possible to arrive at the particular chain of catabolic reactions from considerations of the radioactivity of the gas. On pre-treatment of the roaches with DDT it was found that the combustion of glucose was much faster in the treated than in the control insects. DDT appears to have stimulated preferentially the catabolism of glucose via the phosphogluconate decarboxylation pathway.

200* Trivelloni, J.C. BIOSYNTHESIS OF GLUCOSIDES AND GLYCOGEN IN THE LOCUST. Arch. Biochem. Biophys. 89 (1960) 149-50.

Incubation of fat body preparations from Schistocerca cancellata with uridine diphosphate glucose-C^{14} (UDPG) resulted in the transfer of a part of the radioactivity to the glycogen, and when this was treated with β-amylase, all the radioactivity was liberated as maltose. There was thus enzymic transfer of glucose residues from the UDPG to the ends of the glycogen primer chain by the formation of $\alpha(1\rightarrow4)$ linkages. Incubation of fat body extracts with labelled glucose-1-phosphate also led to some incorporation of radioactivity into glycogen so that some synthesis of glycogen could be taking place under the action of phosphorylase. (See Advances in Insect Physiology 1: 1963, 117).

201 Vardanis, A. GLYCOGEN SYNTHESIS IN THE INSECT FAT BODY. Biochim. biophys. Acta 73, 4 (1963) 565-73.

A tissue extract prepared from the fat body of the American cockroach, Periplaneta americana L., has been shown to contain UDPG-pyrophosphorylase (EC 2.7.7.9) and UDPG-glycogen transglucosylase (EC 2.4.1.11) activity. The latter enzyme is not stimulated by Glc-6-P. Addition of Glc-1-P to the system results in a substantial enhancement of C^{14}-labelled glucose incorporation from UDPG*. The present evidence suggests that Glc-1-P is a true activator of UDPG-glycogen transglucosylase of the cockroach fat body. (Auth. summary).

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* α-1,4-glucan α-4-glucosyl transferase

202 Wimer, L.T. BIOCHEMICAL CHANGES ASSOCIATED WITH GROWTH AND DEVELOPMENT OF THE LARVAL BLOWFLY, Phormia regina, Meigen. Diss. Abstr. 24, 6 (1963) 2631-2.

Radioactive glucose was used as substrate for investigating certain biochemical changes associated with growth and development of the larva. Larvae were reared under rigidly controlled conditions in order to eliminate variations of environmental and nutritional origin. Larval weight was usable as a basis for the determination of physiological age with a minimum of variation in stage of development. The wet weight and dry weight of the whole larva and of the fat body were determined, and the percent of larval dry weight represented by the fat body calculated. The growth of the fat body was then compared with that of other selected larval tissues on the basis of dry weight determinations. The % radioactivity incorporated into the various body tissues and evolved as Co_2 was measured following the dissection of larvae previously injected with glucose uniformly labelled with C^{14}. An evaluation of the data indicated that the fat body is important in the synthesis and storage of glucose meabolites. The fat body was fractionated and analyzed for its major organic components. The total amounts of fat, carbohydrate (glycogen and other anthrone positive material), and protein were determined. An analysis of the % radioactivity incorporated into these fractions was then made, and the data discussed with reference to larval growth and development. The importance of biochemical investigations of this type in the study of hormonal control mechanisms is mentioned.

See also:

135 Assimilation de la cellulose et microorganismes intestinaux chez Gryllus bimaculatus De Geer (Insecte, Orthoptère, Grylloidea). (Martoja, 1962)

151 Biochemistry of diapause, development, and injury in silkworm pupae. (Wyatt, 1963)
411 Radioisotopes and the insect central nervous system. (Treheme, 1962)
422 Nucleotides and other phosphorus compounds of the cockroach central nervous system. (Heslop and Ray, 1961)
427 The biochemistry of the insect fat body. (Kilby, 1963)
430 The exchange and metabolism of sugars in the central nervous system of Periplaneta americana L. (Treherne, 1962)
438 Transfer of substances between the blood and central nervous system in vertebrate and invertebrate animals. (Treherne, 1962)
696 Radioisotope studies of pesticide metabolism by the pineapple plant. (Gortner, 1962)

I-B-4 AMINO ACIDS. PROTEINS. ENZYMES. HORMONES

Surveys

203 Chen, P.S. FREE AMINO ACIDS IN INSECTS. p.115-35 in "Amino Acid Pools. Distribution, Formation and Function of Free Amino Acids. Proceedings of a Symposium on Free Amino Acids held at the City of Hope Medical Centre, Duarte, Calif., U.S.A., May 1961". Holden, J.T., Ed. Amsterdam, Elsevier Publishing Company. 1962.

Comprehensive review of the field. In some of the 198 studies mentioned radioisotopes were used but this fact is not emphasized. Most of the literature quoted is pre-1960.

204 Brunet, P.C.J. TYROSINE METABOLISM IN INSECTS. Ann. N.Y. Acad. Sci. 100, Pt. II (1963) 1020-34.

Review article with extensive bibliography. Many radioisotope references are included in the survey, drawn from studies on a variety of different insects.

205 Karlson, P. ON THE CHEMISTRY AND MODE OF ACTION OF INSECT HORMONES. Gen. Comp. Endocr., Suppl. 1 (1962) 1-7.

After a review of the chemistry and physiology of ecdysone, a new hypothesis is presented for its mode of action. According to this hypothesis, the primary site of hormonal action is the nucleus of the cell. The hormone influences the activity of the gene, i.e. it stimulates (or depresses) the biosynthesis of the specific ribonucleic acid (RNA). The RNA is then transferred to the cytoplasm and becomes part of the ribosomes. The ribosome is the site of protein synthesis; consequently the ultimate result is the synthesis of a specific protein. In the case of Calliphora, it may be one of the enzymes which are involved in tyrosine metabolism and sclerotization of the cuticle. In the case of other hormones, it may well be some other protein with specific functions in development. (CA 57: 1962, 10368c)

206 Karlson, P. CHEMIE UND BIOCHEMIE DER INSEKTENHORMONE. (Chemistry and biochemistry of insect hormones). Angew. Chem. 75, 6 (1963) 257-65. (In German).

Up-to-date review, dealing with the hormone control of insect development, hormones of the brain, the chemistry of ecdysone, the biogenesis of ecdysone, the influence of ecdysone on chromosomes, ecdysone and the metabolism of tyrosine in insects. Tyrosine metabolites were shown to become incorporated in the cuticle, and labelled tyrosine and dihydroxyphenylalanine have proved to be precursors of sclerotinising chinine, whereas hydrochinone is not incorporated. Further sections are devoted to discussions of the juvenile hormone and other insect hormones, and to pheromones (as distinct from hormones), characterized by being able to effect metabolic contact between individuals of a species.

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207 Agosin, M., Hoskins, W.M., Nagasawa, S., Miskus, R., Michaeli, D. A NEW DDT-METABOLIZING ENZYME IN THE GERMAN COCKROACH. J. econ. Ent. 54, 2 (1961) 340-2.

A new microsomal enzyme system capable of converting DDT to a Kelthane-like product has been found in the German cockroach, Blattella germanica (L.). Kelthane is 4,4'-dichloro-alpha-(trichloromethyl)-benzhydrol. The system requires oxygen, reduced triphosphopyridine nucleotide, magnesium ions and nicotinamide for activity. The enzyme(s) is also present in several strains of the house fly Musca domestica L.

The enzyme assays were conducted in 10 ml Erlenmeyer flasks at 37°C with mechanical shaking. Unless otherwise stated, the atmosphere was air. Glass beads (200 mg) were placed in the flasks, followed by 20 µmoles of C^{14}-DDT in acetone (specific activity 12 000 cpm/µmole.

208 Deleted.

209 Bier, K. AUTORADIOGRAPHISCHE UNTERSUCHUNGEN ZUR DOTTERBILDUNG. (Autoradiographic studies on yolk formation). Naturwissenschaften 49, 14 (1962) 332-3. (In German)

Protein synthesis in the ovary of Calliphora erythrocephala Meig. was investigated by injecting H^3-L-histidine. After 1-15 min, radioactivity was found in the cytoplasm of nurse and follicle cells; 40 min later, however, the pattern changed, increasing radioactivity being noted in the peripheral oöplasm where it formed a very pronounced border region after 80 min. Round complexes appeared in the yolk interior. Amino acids would appear to penetrate into the follicle by two pathways. At first, the H^3-histidine largely accounts for the radioactivity; it reaches the cytoplasm as free amino acid where it is incorporated to replace or take part in the formation of protein molecules. Protein synthesis takes place mostly in the cytoplasm of nurse cells. The change in pattern is to be interpreted as due to the supply of free labelled amino acid being largely exhausted, and labelled protein molecules also reaching the oöcyte in increasing amounts. The steps preceding yolk formation are initiated by the follicular epithelium.

210 Block, R.J., Henry, S.M. METABOLISM OF THE SULPHUR AMINO ACIDS AND OF SULPHATE IN Blatella germanica. Nature, Lond. 191 (1961) 392-3.

B. germanica is able to utilize sulphate-S for the synthesis of methionine and cystine, but also to satisfy its sulphur requirements with homocystine, methionine sulphoxide, cysteic acid, taurine, and β-hydroxyethanesulphonic acid. 1-5 µc of the S^{35}-compound were injected, and the subsequent procedure is described. Results indicate that methionine and cystine are converted in the cockroach to sulphate by at least two pathways: (a) methionine sulphoxide ⇌ methionine → (homocysteine) → (cystathionine) → cysteine → (cysteinesulphinic-acid) → β-sulphinyl pyruvic acid → sulphite → sulphate; or (b) methionine → - (homocysteine) - (cystathionine) - cysteine - (cysteinesulphinic-acid) - (2-aminoethane sulphinic acid) → taurine → ? → sulphate. Pathway (a) for the oxidation of cysteine is characteristic of most organisms and is probably the principal method of sulphate production in the cockroach. The results obtained with the aposymbiotic cockroaches were not due to traces of aureomycin carried over from the maternal diet. The hypothesis that the intracellular symbionts are responsible for converting sulphate-S into methionine-S-cystine-S could be substantiated in an experiment involving the destruction of the gut micro-flora while retaining the intra-cellular symbionts. The effect of temperature on sulphate utilization in xenic cockroaches was also studied.

211* Brenner-Holzach, O., Leuthardt, F. UNTERSUCHUNGEN ZUR BIOSYNTHESE DER PTERINE BEI Drosophila melanogaster. (Study on the biosynthesis of pterins in Drosophila melanogaster). Helv. chim. Acta 42, 6 (1959) 2254-7. (In German).

Larvae of D. melanogaster (wild type and mutant Sepia) were fed with C^{14}-labelled glycine, formate and glucose and the specific radioactivity in uric acid and pterines of the flies was measured. These experiments showed that C atoms of glucose are specifically incorporated in the pterines but not in the purines. Possible pathways are discussed. (Essentially auth. summary)

212 Brenner-Holzach, O., Leuthardt, F. BIOGENESIS OF PTERINS WITH Drosophila melanogaster. Helv. chim. Acta 44 (1961) 1480-95. (In German).

Larvae of the wild type of D. melanogaster and of 2 mutants (rosy and sepia) were fed labelled glycine-U-C^{14}, formate-1-C^{14}, glucose-6-C^{14}, and the specific radioactivity in isoxanthopterin, drosopterin, sepiapterin, and uric acid of the flies determined after isolation by paper chromatography. C-6 and -7 of the pteridine ring were isolated as oxalic acid after degradation with Cl followed by acid hydrolysis, the pyrimidine ring being unattacked. The method was tested by the degradation of the synthetic isoxanthopterin-6-C^{14} and -4a-C^{14}. The experiments with glucose-U-C^{14} and glucose-1-C^{14} proved that C atoms of the glucose were specifically used to build up the pyrazine ring of the pteridines. They furnished C-6 and 7 of the pteridine skeleton. After feeding glucose-6-C^{14}, drosopterin, a pterin with a C$_3$ side chain, had much higher activity than isoxanthopterin. The synthesis of pterins was discussed. It was suggested that a pterin with side chain was the primary product of pteridine synthesis. (CA 56: 1962, 7815e)

213* Bricteux-Grégoire, S., Dewandre, A., Florkin, M., Verly, W.G. CONTRIBUTIONS À LA BIOCHIMIE DU VER À SOIE. XI. UTILISATION DU CARBONE DU FORMIATE POUR LA BIOSYNTHÈSE DES ACIDES AMINÉS DE LA FIBROÏNE DE LA SOIE. Arch. int. Physiol. Biochim. 67, 4 (1959) 687-92.

Quand du formiate-^{14}C est introduit dans l'hémocoele à la fin de la période d'alimentation, le ^{14}C incorporé à la fibroïne de la soie apparaît principalement dans le C-3 de la sérine et de l'alanine isolées à partir de cette protéine. Une certaine activité apparaît toutefois dans tous les carbones de la glycine, de la sérine et de l'alanine. La participation du pyruvate au cycle de Krebs est invoquée pour expliquer cette observation. D'autre part l'activité qui apparaît dans le C-1 de la glycine et de la sérine est supérieure à l'activité du C-2 de ces mêmes acides aminés. Pour expliquer ces constatations, des hypothèses supplémentaires sont formulées. La fraction du formiate injecté incorporée dans la glycine, l'alanine et la sérine de la fibroïne de la soie est de l'ordre de quelques unités pour cent. (Conclusions)

214* Bricteux-Grégoire, S., Dewandre, A., Florkin, M. CONTRIBUTIONS À LA BIOCHIMIE DU VER À SOIE. XVI. CONVERSION DE LA THRÉONINE EN GLYCINE, SÉRINE ET ALANINE DE LA FIBROÏNE DE LA SOIE. Arch. int. Physiol. Biochim. 68, 2 (1960) 281-4.

Chaque larve d'un groupe de 20 individus au 5^e âge, pris juste avant la dernière défécation, a reçu une injection de 34 µg de L-thréonine-^{14}C marquée uniformément. L'activité spécifique du produit étant de 7 mc/mM, chaque larve a reçu 2 µc. Toutes les larves sauf une ont filé leur cocon normalement. Les cocons ont été coupés et débarrassés des nymphes 7 j après l'injection. Le ver à soie, comme le rat, est capable de transformer la thréonine en glycine. L'activité spécifique de la sérine étant intermédiaire entre celle de la glycine et celle de l'alanine, il est vraisemblable que la sérine est un intermédiaire entre la glycine et l'alanine. La conversion de glycine en sérine a été démontrée chez le ver à soie (Nature 182: 1958, 1515). 6% seulement de la thréonine injectée ont été transformés en glycine de la fibroïne.

215 Bricteux-Grégoire, S., Dewandre, A., Florkin, M. CONTRIBUTIONS À LA BIOCHIMIE DU VER À SOIE. XVIII. UTILISATION DES ACIDES GLUTAMIQUE ET ASPARTIQUE POUR LA SYNTHÈSE DES ACIDES AMINÉS DE LA FIBROÏNE DE LA SOIE. Biochem. Z. 333 (1960) 370-6.

De l'acide aspartique-3-^{14}C (d'une activité spécifique de 0,88 mc/mM) et de deux variétés d'acide glutamique (acide glutamique-3,4-^{14}C, d'activité spécifique 2,3 mc/mM et acide glutamique-2-^{14}C, d'activité spécifique 0,61 mc/mM) ont été injectés à des vers à soie après la fin de la période d'alimentation (juste avant la dernière défécation). Les résultats indiquent une utilisation intense de ces acides pour la synthèse des acides aminés de la fibroïne de la soie, en particulier pour celle de l'alanine. Il apparaît que l'alanine de la fibroïne trouve son origine majeure dans les acides aspartique et glutamique, qui sont les acides aminés quantitativement les plus importants de la feuille de mûrier. La localisation du ^{14}C permet de discuter les relations métaboliques des acides aspartique et glutamique avec les acides aminés de la fibroïne.

216 Bricteux-Grégoire, S., Florkin, M. CONTRIBUTIONS À LA BIOCHIMIE DU VER À SOIE. XXVI. UTILISATION DU GLUCOSE POUR LA SYNTHÈSE DE LA FIBROÏNE DE Bombyx mori L. Arch. int. Physiol. Biochim. 70, 5 (1962) 711-7.

Trois variétés de glucose marqué (glucose-1-^{14}C, glucose-2-^{14}C, glucose-6-^{14}C) ont été injectées à des vers à soie. Une grande partie de l'activité injectée (15-33%) se trouve dans l'alanine, la sérine, la glycine, l'acide glutamique et l'acide aspartique. La tyrosine de la fibroïne n'a incorporé aucune activité. Les résultats obtenus cadrent avec la notion selon laquelle la glande séricigène peut synthétiser à partir du pyruvate ou des substances fournissant du pyruvate les acides aminés de la fibroïne, à l'exclusion de la tyrosine.

217 Brunet, P.C.J. SYNTHESIS OF AN AROMATIC RING IN INSECTS. Nature, Lond. 199 (1963) 492-3.

In view of the importance of 3,4-dihydroxyphenol to insects a preliminary attempt was made to discover the metabolic pathway to protocatechuic acid (I). These experiments involved injecting substances labelled with C^{14} suspected of being precursors of I and assaying egg capsules and colleterial gland for radioactive I and its precursors. Uniformly labelled tyrosine (0.4 µc) and glucose-1-C^{14}(1 µc) were used. In the female cockroach (Periplaneta americana) the evidence showed that I could be synthesized either from tyrosine or from glucose, but that different metabolic pathways appear to be followed.

218 Candy, D.J., Kilby, B.A. STUDIES ON CHITIN SYNTHESIS IN THE DESERT LOCUST*. J. exp. Biol. 39 (1962) 129-40.

The chitin content of locust cuticle (from leg, thorax, abdomen and wing) increases rapidly after the final molt to the adult form and reaches maximum ca. 300 h after moult. C^{14}-glucose injected into the haemolymph gives rise to labelled chitin. Cell-free extracts of adult wing can convert glucose into uridine diphosphate N-acetylglucosamine (UDPAG) by a pathway involving hexokinase, phosphohexose isomerase, glutamine transaminase, phosphoglucosamine transacetylase, acetyl coenzyme-A synthetase, phosphoacetylglucosamine mutase and UDPAG-pyrophosphorylase. The utilisation of UDPAG in chitin biosynthesis could not be demonstrated in vitro. (Auth.)

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* Schistocerca gregaria (Forsk.)

219 Cline, R.E., Pearce, G.W. UNIQUE EFFECTS OF DDT AND OTHER CHLORINATED HYDROCARBONS ON THE METABOLISM OF FORMATE AND PROLINE IN THE HOUSEFLY. Biochemistry 2, 4 (1963) 657-62.

Inceticide-treated and control flies were injected with C^{14}-labelled biochemicals, and 3 h later the soluble radiometabolites were extracted for identification and assay by paper chromatography and radiometric techniques. Of the injected compounds, DDT was found to interfere most with the metabolism of formate, glycine, and proline. Thus after injection of formate-C^{14}, more uric acid and allantoin, and less proline were recovered as radiometabolites from flies treated with DDT and related chlorinated hydrocarbon insecticides than from flies untreated or treated with non-toxic analogues. However, insecticides of other types such as pyrethrum, organic phosphates, and phosphonates and a carbamate failed to show a significant effect on formate metabolism, providing additional evidence for a different mode of action. (Auth.)

220 Corrigan, J.J., Srinivasan, N.G., Meister, A. STUDIES ON THE ORIGIN OF D-SERINE IN THE JAPANESE SILKWORM. (Abstr.78). Bull. ent. Soc. Amer. 9, 3 (1963) 164.

To investigate the source of the D-serine previously found (J. Biol. Chem. 237: 1962, PC3844) in Bombyx mori C^{14} glucose and C^{14}-L-serine were injected into late last-instar larvae. Evidence for conversion to D-serine was obtained in these experiments and also in studies with tissue homogenates.

221 Corrigan, J.J., Kearns, C.W. AMINO ACID METABOLISM IN DDT-POISONED AMERICAN COCKROACHES. J. Insect Physiol. 9, 1 (1963) 1-12.

Amino acids were quantitatively compared in haemolymph from DDT-poisoned and DDT-treated, but symptom-free, Periplaneta americana. Symptoms were induced by holding insects at a lower temperature in accordance with the negative temperature coefficient of DDT action. While most amino acids were unchanged, proline was depleted in paralysed insects. As the duration of paralysis increased, proline progressively decreased to $\frac{1}{4}$ the normal blood concentration. Relief of symptoms resulted in restoration of proline to the normal concentration. Identical effects were observed with TDE-poisoned cockroaches and tobacco hornworms, but other insecticides failed to produce this reversible depletion. Injection of C^{14}-L-proline (U) into cockroaches followed by induction of DDT symptoms revealed that three times as much oxidation of proline carbon to CO_2 occurred in insects with symptoms as in the controls. An increase in C^{14}-glutamine was observed in the blood and central nerve of poisoned insects. It was postulated that symptoms of DDT shift the demand for oxidizable carbon to proline. This could result from the inhibition of one or more oxidative enzymes above the level of alpha-ketoglutaric acid. (Auth.)

222 Devi, A., Lindsay, P., Sarkar, N.K. SYNTHESIS AND BREAKDOWN OF PROTEINS AND RIBONUCLEIC ACID IN Tribolium confusum. Experientia 19, 7 (1963) 344-5.

The incorporation of leucine-C^{14} into proteins and of uridine-C^{14} into RNA was determined at various stages of the insect life. The rate of incorporation into proteins increases slowly but regularly in the initial stages of growth, but during the latter part of the larval period (6-12 d) the rate increases sharply; during 13-16 d the specific activity of the labelled protein does not significantly change. At the pupal stage (17-20 d) the specific activity drops and then rises slowly thereafter. The drop occurs while the insect does not take food. The curve for RNA is similar but the rises occur sooner. Maximum incorporation occurs between 4-10 d. RNA synthesis precedes protein synthesis and the protein synthesis can be considered an index of growth of the insect. (CA 59: 1963, 5546d).

223 Fox, A.S., Kang, S-H. AMINO ACID INCORPORATION INTO PROTEIN BY CELL-FREE PREPARATIONS OF Drosophila melanogaster. p.201 in "XVI International Congress of Zoology, Washington, August 20-27, 1963. Vol.II". Moore, J.A., Ed. Washington D.C., XVI International Congress of Zoology.

(See 224)

224 Fox, A.S., Kang, S-H. AMINO ACID INCORPORATION INTO PROTEIN BY CELL-FREE PREPARATIONS OF Drosophila melanogaster. (Abstr.850). Fed. Proc. 22, 2 (1963) 303.

C^{14}- or H^3-leucine is incorporated into protein in cell-free preparations from D. melanogaster. Mitochondria are not required and are removed from homogenates of adults or larvae by centrifugation at 15000 X g. Microsomes are sedimented at 125000 X g. SRNA and pH5 fraction are prepared from the supernatant by the phenol method and precipitation respectively. Incorporation requires microsomes, pH5 fraction or SRNA, 20 amino acids, ATP and generating system, GTP, and Mg^{++}. Total TCA precipitable counts, hot TCA insoluble counts (protein-bound), and hot TCA soluble counts (nucleotide-bound) all increase linearly for 25 min and reach a plateau after 40 min of incubation at 37°C, indicating a possible requirement for replacement of mRNA. Rate of incorporation with excess pH 5 fraction is linear with microsome concentration; with excess microsomes it is linear with pH 5 fraction. (From abstr.)

225 Friedman, S. RATE OF EQUILIBRATION OF THE CONTENTS OF THE GUT OF Anopheles quadrimaculatus LARVAE WITH THE SURROUNDING MEDIUM. Nature, Lond. 200 (1963) 605-6.

A marked improvement in the growth rate of culicine larvae had been reported when protein in suspension replaced protein in solution in the medium. In order to determine the rate of equilibration of a small, highly soluble molecule between the surrounding medium and the gut of the 4th instar larvae of A. quadrimaculatus Say, larvae were exposed for varying periods to solutions of sodium acetate-1-C^{14} (25 μc/ml) and their guts homogenized, plated out and counted. The present study indicates that soluble protein enters the gut at the same rate as any particulate matter, passing the peritrophic membrane to fill the entire lumen, experimentally estimated at 0.07 μl. A 2% solution of soluble protein could be shown to provide, at any given time, ~19% of the amount of protein, both available and unavailable, which might be present in the gut due to ingestion of bacteria, but only 4% of this amount in a suspension of pure protein.

226* Frontali, N. GLUTAMIC ACID CARBOXYLASE IN THE NERVOUS TISSUE OF INSECTS. Boll. Soc. ital. Biol. sper. 35 (1959) 2154-5.

Homogenized cephalic ganglia of bees is incubated with C^{14}-labelled glutamic acid in an atmosphere of N for 1 h. The mixture is deproteinized, chromatographed bidimensionally, and the spots detected by radioactivity. R_f value and confirmatory tests show that one of the spots is glutamic acid carboxylase. Further quantitative radioactivity measurements show that the enzyme present in bees is 60% of that found in the brain of mice. Other tests using Warburg's CO_2 method on homogenized heads of Musca domestica and the brain of mice proved inconclusive. (CA 57: 1962, 11679b)

227 Fukuda, T., Kameyama, T. BIOCHEMICAL STUDIES ON THE FORMATION OF SILK PROTEIN. XIII. THE SYNTHESIS OF GLYCINE FROM GLYCOLIC ACID IN THE SILKWORM LARVA. Nippon Sanshigaku Zasshi 30 (1961) 437-41.

The glycine-isolated from the fibroin produced by the silkworms that consumed the glycolic acid-I-C^{14} had a comparatively higher concentration of C^{14} and all the radioactivity was located in the carboxyl C atom of glycine. A comparatively higher concentration of the C^{14} appeared in the glyoxylic acid isolated from the body fluid of the silkworms that consumed glycolic acid-1-C^{14}. These facts seem to suggest that glycolic acid is used for formation of glycine via glyoxylic acid, and that this reaction plays an important role in the glycine synthesis in silkworm larva. (CA 60: 1964, 897f)

228* Fuzeau-Braesch, S. BIOLOGICAL AND BIOCHEMICAL STUDIES OF PIGMENTATION OF SOME INSECTS, Gryllus bimaculatus. Bull. biol. 94 (1960) 525-627. (In French).

A genetic variability was observed which permitted the selection of bright and dark strains. The population density determines the threshold; beyond the genotype, only the dark phenotype is formed. The hypodermal pigment is ommochrome, established as melanin by means of tryptophan-C^{14} and tyrosine incorporation, as well as by chemical analysis. A yellow and black pigment arises from tyrosine, apparently through the action of a cuticle phenolase complex on intermediary products. (From CA 60: 1964, 14892d)

229 Fuzeau-Braesch, S. ÉTUDE DE LA PIGMENTATION TÉGUMENTAIRE DES INSECTES A L'AIDE DE RADIO-ÉLÉMENTS. p.289-96 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Les substances suivantes ont été utilisées: (1) 1-tyrosine, marquée uniformément au ^{14}C, (2) tryptophane marqué au ^{14}C, 1er atome de la chaîne, (3) sulfate de sodium marqué au ^{35}S, (4) dl-méthionine marqué au ^{35}S, et (5) dl-cystine marqué au ^{35}S. Les insectes hétérométaboles suivants ont été injectés: Gryllus bimaculatus de Geer avec les substances 1-5, Locusta migratoria avec la substance 1. L'élément choisi est injecté à differents moments du cycle de mue: avant la sécrétion des protéines cuticulaires, la cuticule étant alors au repos; au moment du dépôt de ces protéines; à l'instant où commence le processus de sclérification de ces protéines. Après un laps de temps adéquat la cuticule est prélevée, traitée de façon appropriée et autoradiographiée in toto. La comparaison photographique des résultats permet de conclure à l'utilisation ou non de l'élément choisi dans telle formation pigmentaire, compte tenu des processus chimiques antérieurs relatifs à l'élément. Les pigments cuticulaires sont tous issus du métabolisme de la tyrosine, confirmant le terme de «mélaniques» qui leur était jusqu'à présent attribué sans preuve directe. Le tryptophane, exceptionnellement intégré dans la cuticule, constitute le substrat des pigments noirs et rouges ommochromiques de l'hypoderme. Le soufre inorganique ne joue pas de rôle spécifique régulier dans la formation des pigments cuticulaires, contrairement à ce que laissaient supposer différentes hypothèses sur le rôle des groupements sulfhydriles. Du point de vue de la biochimie comparée, les mélanines semblent être chez les insectes exclusivement cuticulaires, les granulaires étant réservées aux vertébrés. Quant aux granules hypodermiques sombres, ils sont, chez les insectes, de nature ommochromique, dérivés du tryptophane et non mélaniques.

230 Henry, S.M., Block, R.J. THE SULFUR METABOLISM OF INSECTS. VI. METABOLISM OF THE SULFUR AMINO ACIDS AND RELATED COMPOUNDS IN THE GERMAN COCKROACH, Blattella germanica (L.) Contr. Boyce Thompson Inst. 21 2 (1961) 129-45.

The metabolism of S^{35}-labelled cystine, cysteine, cysteinesulfinic acid, taurine, methionine, methionine sulfoxide, methionine sulfone, and C^{14}-labelled serine was studied in the German cockroach, Blattella Germanica (L.). Neither cysteinesulfinic acid nor cysteic acid was used for the synthesis of cysteine. Taurine was partially utilized only after degradation to sulfate by intestinal microorganisms. C^{14}-labelled cysteine was produced by cockroaches injected with serine-C^{14} together with sulfate, sulfite, or thiosulfate. These data indicate that the synthesis of cysteine in the cockroach proceeds via condensation of either sulfide or thiosulfate with serine. Cysteine was found to undergo the following reactions in the cockroach: incorporation into protein, transsulfuration to methionine when intracellular symbionts are present, and degradation to taurine and sulfate by pathways conforming with those known to occur in other organisms. Methionine and methionine sulfoxide were found to be interconvertible. Demethiolation, incorporation into protein, conversion to cysteine, and degradation to sulfate and other compounds were observed. Methionine sulfone was not metabolized. (Auth.)

231 Henry, S.M., Block, R.J. THE SULFUR METABOLISM OF INSECTS. VII. THE METABOLISM OF THE SULFUR AMINO ACIDS AND OF SULFATE IN THE BLOWFLY, Phormia regina (Meig.). Contr. Boyce Thompson Inst. 21, 7 (1962) 447-52.

The interrelationships of sulfate, cystine, and methionine in Phormia regina (Meig.) were investigated using S^{35}-labelled metabolites. The blowfly was unable to use sulfate for synthesis of the sulfur-containing amino acids. Methionine-S was converted to cystine-S and glutathione-S and was incorporated into protein. Cysteine and cystine were incorporated into protein and were degraded to taurine and sulfate but were not used in the synthesis of methionine. Sulfur metabolism in this insect, therefore, resembles that of most other insects and higher animals. Failure to synthesize methionine from cystine or sulfate is considered indicative of a dietary requirement for either methionine or a suitable thiomethyl precursor. (Auth.)

232 Henry, S.M., Block, R.J. AMINO ACID SYNTHESIS, A RUMEN-LIKE EFFECT OF THE INTRACELLULAR SYMBIONTS OF THE GERMAN COCKROACH. (Abstr.) Fed. Proc. 21, 2 (1962) 9.

Glucose-U-C^{14} was fed as a 2% solution with a vitamin mixture consisting of choline, folic acid, nicotinamide, pantothenic acid, pyridoxal, thiamin, and riboflavin to xenic Blatella germanica (L.) and to aposymbiotic B. germanica obtained by feeding the parents aureomycin. After grinding and extracting with 80% ethanol, the proteinaceous residue was hydrolyzed in acid. The amino acid areas were eluted from 2-dimensional chromatograms and the radioactivity was measured with a glass flow counter. The amino acids of the xenic cockroach, listed in order of decreasing radioactivity, were glutamic acid, alanine, aspartic acid, tyrosine, serine, proline, glycine, lysine, histidine, phenylalanine, threonine, isoleucine, valine, and arginine. Aposymbiotic cockroaches failed to synthesize tyrosine, phenylalanine, isoleucine, valine, arginine, and probably threonine from glucose. The necessity for symbionts for the synthesis of cystine and methionine from inorganic sulfate has been demonstrated previously (Henry & Block, Contrib. Boyce Thompson Inst., 20, 317, 1960). The data thus indicate that the symbionts perform biochemical functions similar to those of rumen microorganisms. Impairment of tyrosine synthesis may be partially responsible for the light color of symbiont-free cockroaches.

233 Henry, S.M., Cook, T.W. METABOLISM OF CYSTATHIONINE IN Blatella germanica (L.). (Abstr.79) Bull. ent. Soc. Amer. 9, 3 (1963) 164.

Cystathionine-S^{35}, injected into xenic and aposymbiotic German cockroaches, was cleaved rapidly to cysteine. Some conversion to methionine, presumably via homocysteine, also occurred. The latter is surprising inasmuch as only plants and some microorganisms are known to be able to effect this conversion.

234 Hopkins, T.L. OXIDATIVE METABOLISM OF ADENINE IN THE MADEIRA COCKROACH. (Abstr. 76). Bull. ent. Soc. Amer. 9, 3 (1963) 164.

Adenine-8-C^{14} injected into adult female Leucophaea moderae was rapidly oxidized to uric acid and stored in the fat body. Minor amounts were excreted in the feces in 12 d and about 3% as C^{14}O$_2$ in 12 h. Adenine-2-C^{14} was also oxidized to C^{14}O$_2$ in the early interval.

235 Jacobs, M.E., Brubaker, K.K. BETA-ALANINE UTILIZATION OF EBONY AND NON-EBONY Drosophila melanogaster. Science 139, 3561 (1963) 1282-3.

C^{14}-labelled β-alanine was injected into newly formed D. melanogaster female pupae. Homozygous ebony deposited less C^{14} in pupal sheaths, deposited more C^{14} in adult body extracts and wings, and decarboxylated and oxidized β-alanine to excrete C^{14}O$_2$ faster than did non-ebony homozygotes. Heterozygotes were intermediate in all these activities. (Auth.)

236 Japan. Sericultural Experiment Station, Tokyo. STUDIES BY CARBON-14 ON THE FORMATION OF THE SILKPROTEIN. (Abstr.). Nucl. Sci. Abstr., Japan 1 3/4 (1962) 170. (In English).

Sodium glycolate-1-C^{14} was used to discover a precursor of glyoxylic acid synthesis. Amino acids (glycine, serine, etc.) were isolated from fibroin produced by silkworm which had consumed 0.5 μc/head of the glycolate on the 4th day of the 5th instar. Radioactivities of the amino acids and the hydrazones isolated were measured. Location and concentration of C^{14} suggest that that glycolic acid is used for glycine formation via glyoxylic acid, and that this reaction plays an important role in the glycine synthesis in silkworm larvae.

237 Japan. Sericultural Experiment Station, Tokyo. METABOLIC PATHWAY OF AMINO ACIDS IN SILKWORM LARVAE IN RELATION TO SILK PRODUCTION. Nucl. Sci. Abstr., Japan 2, 2 (1963) 130-1. (In English).

Silkworms (Nichi 124 x Shi 124) which consumed 0.5 μc/worm of citric acid-1,5-C^{14} (1.1 mc/mM) on the 4th day of the 5th stage were reared on mulberry leaves until cocoons were produced. The fibroin protein was isolated from the radioactive cocoon fibre and the glycine as a salt of 5-nitronaphthalene-1-sulfonate from the fibroin hydrolysate (Stein and Moore procedure). The glycine was then separated from the salt. The amino acid isolated was recrystallized until the specific activity became constant. The chemical purity of the amino acid was established by paper chromatography. The amino acid was also degraded by procedures described by Vernon et al. to determine the distribution of C^{14} in the glycine molecule. In another experiment, glyoxylic acid was isolated as its 2,4-dinitrophenylhydrazone from the body fluid of silkworms which had consumed labelled citric acid on 3rd day of the 5th stage. A higher radioactivity was found in isolated glycine; all the C^{14} appeared at the carbon of the carboxyl group in glycine. A comparatively high radioactivity was also recognized in the hydrazone of glyoxylic acid. The results suggest that glyoxylic acid, a precursor of glycine synthesis, is synthesized from citric acid via the glyoxylate cycle.

238 Jaworski, E., Wang, L., Marco, G. SYNTHESIS OF CHITIN IN CELL-FREE EXTRACTS OF Prodenia eridania. Nature, Lond. 198, 4882 (1963) 790.

The results of a preliminary investigation on the biosynthesis of chitin in the southern army worm, P. eridania, are reported. There are indications that chitin synthesase is present in cell-free extracts. The 6th instar, pre-pupal and pupal stages were used, and the enzyme was obtained by the procedure of Glaser and Brown (J. Biol. Chem. 228: 1957, 729). The total reaction mixture of 1.5 ml consisted of 6×10^{-4} M C^{14}-uridine diphospho-N-acetylglucosamine (3.06×10^4 dpm), 1.12×10^{-2} M N-acetylglucosamine, 5 mg chitodextrin and 1 ml of enzyme preparation. The pellet was labelled with C^{14} which indicated the presence of chitin synthesase; peaking of enzymatic activity occurred at the pre-pupal (or late 6th instar) stage of development, which is about the time when the insect is beginning to form its pupal casing. Results appear consistent with those of Candy and Kilby (218) on the desert locust.

239 Jenny, E., Hicklin, A., Leuthardt, F. IN-VITRO-EINBAU RADIOAKTIVER AMINOSÄUREN IN DIE PROTEINE VON Drosophila-PUPPEN. (In vitro incorporation of radioactive amino acids into proteins of Drosophila pupae). Helv. chim. Acta 45, 6 (1962) 2014-20. (In German, with English summary).

The incorporation of radioactive amino acids into microsomes from D. melanogaster (pupae) is described. Enzymatic incorporation can only be demonstrated after the inhibition (by phenylthiourea) of a very active tyrosinase, which is present in the microsomal fraction. C^{14}-labelled leucine was used. The system has the following properties: (1) It requires ATP, Mg^{++}, an ATP regenerating system, but not GTP. (2) Sucrose-washed microsomes with and without addition of pH 5 enzymes incorporate to the same extent. (3) Microsomes treated with deoxycholate or 0.05 M KCl incorporate less than the untreated ones, the former being nevertheless stimulated by addition of pH 5 enzymes or the pH 5 precipitate of the KCl extract. (4) Rat liver microsomes or pH 5 enzymes can be exchanged with the corresponding fraction from Drosophila. (From auth. summary).

240* Karlson, P. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. III. ÜBER DEN EINBAU VON TYROSIN-UMWANDLUNGSPRODUKTEN IN DAS PUPPENTÖNNCHEN DER SCHMEISSFLIEGE Calliphora erythrocephala. (Tyrosine metabolism in insects. III. The incorporation of tyrosine metabolites in the puparium of the blowfly Calliphora erythrocephala). Hoppe-Seyl. Z. 318 (1960) 194-200. (In German, with English summary).

The last larval cuticle is transformed into the puparium by the incorporation into it of tyrosine metabolites. It has been demonstrated, with uniformly labelled tyrosine, that about 80% of the free tyrosine enters the cuticle. In ligated animals, puparium formation and tyrosine incorporation occur only after injection of ecdysone. Besides uniformly labelled tyrosine, tyrosine-[β-C^{14}] and 3,4-dihydroxy-phenylalanine-[β-C^{14}] are incorporated but not hydroquinone-[2,3,5,6-C^{14}]. Contrary to the hypothesis of Dennell, it is concluded that the sclerotization is due to the action of o-quinones, and that the elimination of the side chain plays only a minor part in the reaction sequence. (Auth. summary)

241 Karlson, P., Sekeris, C.E., Sekeri, K.E. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. VI. IDENTIFIZIERUNG VON N-ACETYL-3, 4-DIHYDROXY-β-PHENÄTHYLAMIN (N-ACETYL-DOPAMIN) ALS TYROSINMETABOLIT. (Tyrosine metabolism of insects. VI. Identification of N-acetyl-3,4-dihydroxy-β-phenethylamine (N-acetyl-dopamine) as a tyrosine metabolite). Hoppe-Seyl. Z. 327 (1962) 86-94. (In German, with English summary).

A new metabolite, N-acetyl-dopamine, has been isolated from larvae of the blowfly, Calliphora erythrocephala. This compound was hitherto unknown, and was also synthesized for comparison from dopamine. N-acetyl-tyramine and the 4-O-β-glucoside of N-acetyl-dopamine were also found in the extracts. The incorporation of [α-C^{14}] N-acetyl-dopamine and generally labelled N-acetyl-tyramine (their preparation is described) into the cuticle was studied. In a comparative incorporation experiment, N-acetyl-dopamine and dopamine were the most efficient precursors of the sclerotisation material. It is concluded that N-acetyl-dopamine is the phenolic precursor of the sclerotising quinones. (Auth.)

242 Karlson, P., Schlossberger-Raecke, I. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. VIII. DIE SKLEROTISIERUNG DER CUTICULA BEI DER WILDFORM UND DER ALBINOMUTANTE VON Schistocerca gregaria Forsk. (Tyrosine metabolism of insects. VIII. Cuticle sclerotization in the wild form and the albino mutant of Schistocerca gregaria Forsk.) J. Insect. Physiol. 8 (1962) 441-52. (In German).

The albino strain of Schistocerca differs from the wild type in having no melanin while the sclerotization of the cuticle is virtually unaltered. A preliminary survey of the tyrosine metabolism of the two strains revealed that there are no qualitative but only minor quantitative differences in tyrosine content, phenoloxidase activity, and incorporation of radioactive precursors into the sclerotin of the cuticle. It is concluded

that the mutation to albino influences only processes in melanized parts of the cuticle, and that the main pathway of tyrosine metabolism, i.e. sclerotization and tanning of the cuticle, is not affected. Some observations on the incorporation of metabolites into the ecdysial membrane are reported and discussed. Experiments were carried out with radioactive preparations: generally labelled L-tyrosine (specific activity 9 mc/mM), DL-tyrosine-α-C^{14}(0.5 mc/mM) DL-dihydroxyphenylalanine (DOPA)-α-C^{14} (0.5 mc/mM). Depending on activity the dose/animal was 4-33 µg. The solutions were injected as shortly as possible before moulting. Animals were killed at intervals after moulting, the cuticles were prepared and the radioactivity of the ashes determined.

243 Karlson, P., Sekeris, C.E. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. IX. KONTROLLE DES TYROSINSTOFFWECHSELS DURCH ECDYSON. (Tyrosine metabolism of insects. IX. Control of tyrosine metabolism by ecdysone). Biochim. biophys. Acta 63 (1962) 489-95. (In German, with English summary).

Changes in tyrosine metabolism have been observed during development of Calliphora erythrocephala larvae. In younger larvae (early 3rd-instar), tyrosine is mainly transaminated, while in older larvae conversion to 3,4-dihydroxyphenylalanine and decarboxylation to 3,4-dihydroxyphenylethylamine is predominant. This metabolic shift is prevented by ligation (elimination of the ecdysone-producing ring gland). In ligated abdomens as well as in intact animals, decarboxylase activity is enhanced by injection of ecdysone. It is concluded that one of the characteristic biochemical effects of ecdysone is the induction of the decarboxylating enzyme, possibly by interaction with the genetic material. Generally labelled preparations, L-[C^{14}] tyrosine and L-[2'-C^{14}] DOPA, were used and were obtained from the Radiochemical Centre Amersham and the California Corporation for Biochemical Research.

244 Karlson, P., Ammon, H. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. XI. BIOGENESE AND SCHICKSAL DER ACETYLGRUPPE DES N-ACETYLDOPAMINS. (Tyrosine metabolism of insects. XI. Biogenesis and fate of the acetyl group of N-acetyldopamines). Hoppe-Seyl. Z. 330 (1963) 161-8. (In German, with English summary).

An acetyl coenzyme A-transacetylase, which acetylates tyramine and dopamine, was demonstrated in blowfly larvae (Calliphora erythrocephala). This transacetylase system reacted with histamine and serotonin, but not with glucosamine, tyrosine, dopa, or amino acids. Its activity was unaffected by ecdysone. No significant change was seen due to age of the insect. The C^{14}-labelled acetyl grouping was incorporated into the cuticula during sclerotization. The incorporation was also followed by radioautography. Sclerotization could be inhibited by ultraviolet irradiation. The following, generally labelled, radioactive preparations were used: [C^{14}]-L-tyrosine, [α-C^{14}] DL-dopa, [α-C^{14}] dopamine, [α-C^{14}] tyramine, and [1-C^{14}] acetanhydride.
[For XII., See 279]

245 Karlson, P., Sekeris, C.E. N-ACETYL-DOPAMINE AS SCLEROTIZING AGENT OF THE INSECT CUTICLE. Nature, Lond. 195 (1962) 183-4.

Evidence is presented for the identification of N-acetyl-dopamine (a metabolite of tyrosine in blowfly - Calliphora erythrocephala - larvae) as the tanning agent in puparium formation. Some data had been obtained by means of radioactive N-acetyl-dopamine labelled at the β-C-atom, which is readily incorporated into the cuticle. The incorporation is as high as that of tyrosine, within experimental error. If only the acetyl group of N-acetyl-dopamine is labelled, the radioactivity is, furthermore, found mainly in the cuticle. Hence it could be concluded that N-acetyl-dopamine is incorporated as a whole molecule.

246 Karlson, P., Hoffmeister, H. ZUR BIOGENESE DES ECDYSONS. I. UMWANDLUNG VON CHOLESTERIN IN ECDYSON. (An investigation of the biogenesis of ecdysone. I. Transformation of cholesterin into ecdysone). Hoppe-Seyl. Z. 331 (1963) 298-300. (In German, with English summary).

H^3-labelled cholesterin (50 mg in an aqueous suspension, with a total activity of 25 mc) was injected into (1000) larvae of Calliphora erythrocephala. The larvae were killed 36 h later, extracted with methanol, followed by the technique described by Karlson et al. in Liebigs Ann. Chem. 662: 1963, 1. Extraction and purification gave a crude radioactive ecdysone. Cocrystallization with unlabelled ecdysone yielded pure ecdysone with constant specific activity (0.97×10^3 cpm/mg). It is concluded that cholesterol is the precursor of ecdysone.

247 Kasting, R., McGinnis, A.J. NUTRITION OF THE PALE WESTERN CUTWORM, *Agrotis orthogonia* Morr. IV. AMINO ACID REQUIREMENTS DETERMINED WITH GLUCOSE-U-C^{14}. *J. Insect Physiol.* *8*, 1 (1962) 97-103.

An indirect method using glucose-U-C^{14} to determine amino acid requirements was applied to 5th instar larvae of the pale western cutworm, *Agrotis orthogonia* Morr. $C^{14}O_2$ was produced after glucose-U-C^{14} was injected, indicating that the substrate was metabolized. The amino acids, alanine, aspartic acid, glutamic acid, proline, serine, and cysteic acid, isolated from the larvae contained relatively large quantities of radioactivity and were classed as nutritionally non-essential. Phenylalanine, arginine, lysine, histidine, leucine, isoleucine, and cystine contained little radioactivity and were classed as nutritionally essential. Methionine is probably essential also. The requirement for threonine remains in doubt. Tyrosine was not synthesized appreciably from glucose-U-C^{14} but was readily formed from phenylalanine. (Auth.)

248 Kasting, R., Davis, G.R.F., McGinnis, A.J. NUTRITIONALLY ESSENTIAL AND NON-ESSENTIAL AMINO ACIDS FOR THE PRAIRIE GRAIN WIREWORM, *Ctenicera destructor* Brown, DETERMINED WITH GLUCOSE-U-C^{14}. *J. Insect Physiol.* *8*, 11/12 (1962) 589-96.

Valine, lysine, phenylalanine, arginine, histidine, threonine, leucine, isoleucine, and tyrosine were not readily synthesized from glucose-U-C^{14} by the prairie grain wireworm and, except for tyrosine, are classed as nutritionally essential. Tyrosine was readily formed from phenylalanine. Although methionine and glutamic acid were synthesized to a limited extent, they are considered to be nutritionally essential also. In contrast, proline, alanine, aspartic acid, serine, and glycine were readily synthesized from glucose-U-C^{14} and are classed as nutritionally non-essential. A peptide containing leucine, glycine, and glutamic acid was demonstrated and may be of nutritional significance. The relative quantities of the common amino acids found in this insect are presented. (Auth.)

249 Kirsten, E., Kirsten, R., Arese, P. DAS VERHALTEN VON FREIEN AMINOSÄUREN, ENERGIEREICHEN PHOSPHORSÄURE-VERBINDUNGEN UND EINIGEN GLYKOLYSE- UND TRICARBONSÄURECYCLUS-SUBSTRATEN IN MUSKELN VON *Locusta migratoria* BEI DER ARBEIT. (The behaviour of free amino acids, high energy phosphoric acid compounds and some glycolytic and tricarboxylic acid cycle substrates in the muscles of *Locusta migratoria* at work). *Biochem. Z.* *337*, 2 (1963) 167-78. (In German, with English summary).

Characteristic shifts of the levels of some free amino acids take place in flight muscle of *Locusta migratoria* during flight. Glutamate shows a decrease of ~ 3 μM/gm fresh weight (fw) proline one of ~ 7 μM/gm fw, while aspartate increases by ~ 1 μM/gm fw and free amides (glu-NH_2, asp-NH_2) show an increase of ~ 3 μMol/gm fw. The shifts of glutamate and aspartate are already detectable after 20 sec of flight, while proline and amide begin changing only in later phases of flight. The flight muscle (which is known to perform an intensive aerobic metabolism during flight) shows in anaerobiosis (the animal put into a N_2-atmosphere for 3 min) a significant decrease of glutamate, proline, and aspartate content. Glutamate-U-C^{14} was incorporated to a high rate into aspartate during flight. Alanine rises only in the first phase of flight as well as in anaerobiosis of the flight muscle. Alanine also increases in the jumping muscles during muscular activity (the jumping muscles of *Locusta migratoria* are known to perform a mainly anerobic metabolism in the active state). The shifts of alanine show the same direction as those of pyruvate. The free amide content of jumping muscles also shows an increase of ~ 2 μM/gm fw after 10-15 jumps, while besides alanine no further changes of free amino acid levels are to be observed in the active state. While in the flight muscle of the locust the phosphagen (phosphoryl arginine) content amounts to 6 μM/gm fw in rest and decreases to approximately one half of this value during activity, the leg muscle phosphoryl arginine amounts to 24 μM/gm fw in rest and decreases by ~ 18 μM/gm fw during muscular activity. The corresponding changes within the adenosine triphosphate (ATP) adenosinediphosphate (ADP)-system are comparatively small: ~ 6 μM/gm fw in flight as well as in jumping muscle during rest decrease by 0.4 - 0.5 μM/gm fw during activity. (Auth.)

250 Kondo, Y. THE CYSTATHIONINE PATHWAY IN THE SILKWORM LARVA. *J. Biochem.*, Tokyo *51* (1962) 188-92.

Cystathionine was found to be commonly present in the larval haemolymph of silkworm, including 5 races with white and one with yellow blood, but not in other Lepidopterous insects. The content of cystathionine (*I*) in haemolymph of *Bombyx mori* is detected only after hatching, and is increased to about 130 mg % by feeding mulberry leaves. Following an injection of DL-methionine (*II*)-S^{35} only *I*-S^{35} is found in the blood, but no S^{35}-labelled metabolites of *I* are detected. *II*-S^{35} is metabolized in *Antheraea pernyi* to S^{35}-labelled cystine, taurine, and sulfate, but *I*-S^{35} is not detected. *B. mori* appears to have no cystathionase or of only very low activity while *A. pernyi* appears to have a different pathway of *II* metabolism.

251 Kroeger, H., Jacob, J., Sirlin, J.L. THE MOVEMENT OF NUCLEAR PROTEIN FROM THE CYTOPLASM TO THE NUCLEUS OF SALIVARY CELLS. *Exp. Cell Res.* *31* (1963) 416-23.

Salivary glands from middle to late larvae of *Chironomus thummi* were incubated in their own haemolymph, either with DL-H^3-lysine monohydrochloride or H^3-guanosine (specific activities of 22 and 400 mc/mM) to a final concentration of 50-100 μc/ml. Protein-labelled chromosomes and nucleoli from salivary cells were implanted into the cytoplasm of unlabelled salivary cells. Autoradiographs showed the label to move preferentially into the host nucleus. From comparison with the pattern of uptake of free lysine in controls the transfer of label is considered to take place in protein. This would indicate the presence in the nucleus of protein with nucleotropic affinity.

252 Lewis, S.E., Fowler, K.S. IN VITRO SYNTHESIS OF PHOSPHOARGININE BY BLOWFLY MUSCLE. *Nature*, Lond. *194* (1962) 1178-9.

The *in vitro* effect of arginine on the O_2 uptake by suspensions of thoracic muscle of *Calliphora erythrocephala* was examined. Addition of adenosine diphosphate, or arginine. HCl to the incubation mixture increased the rate of O_2 uptake, measured with a vibrating Pt electrode. Radiometric scanning of chromatograms of the supernatant from the incubation mixture precipitated with EtOH after incubation with arginine and $P^{32}O_4^{3-}$ showed that about 67% of the incubated P^{32} coincided with phosphoarginine detected chemical. This P^{32}-labelled compound was hydrolyzed *in situ*, eluted, and rechromatographed. Two compounds were identified, arginine and P^{32} as inorganic phosphate. Preliminary examination of suspensions of thoracic muscle had shown that on incubation with arginine and adenosine triphosphate, the amount of phosphoarginine produced by the soluble fraction is about 10-fold that produced by the sarcosomes. (CA 57: 1962. 11681g)

253* Lu, K.H., Li, W.Y. THE USE OF LABELED ACETIC ACID IN THE SYNTHESIS OF SILK PROTEIN. *Shih Yen Sheng Hsueh Pao* *6*, 4 (1959) 263-75.

HOAc-C^{14} was injected into an adult caterpillar (*Attacus ricini*). The label disappeared rapidly from the haemolymph and CO_2, while the lipids and proteins remained labelled. The radioactivity of silk protein kept increasing until an equilibrium between them and proteins of the body was established. The protein of the silk cocoon contained approximately 9.2% of the introduced radioactivity, wherein the activity of fibroin and of sericin was almost equal. In the hydrolysis of labelled fibroin, the content of alanine was found to be high. In addition, there were found the following: glycine, leucine, phenylalanine, valine, tyrosine, glutamic and aspartic acids, threonine, serine, arginine, lysine and histidine. Maximum introduction of C^{14} was into alanine, aspartic and glutamic acids, serine, glycine, valine and tyrosine; threonine, leucine and histidine did not contain it. In 5 d, the protein content of silk in each gland increased from 3 mg during the 1st d up to 115.4 mg on the 5th, while ribonucleic acid increased from 380 mg up to 2995.2 mg then decreased in parallel with the disappearance of protein. (CA 58:1963, 19561b)

254 Lu, C.-H., Wang, P.-Y. FIBROIN BIOSYNTHESIS IN *Samia ricini*. *Shih Yen Sheng Wu Hsueh Pao* *8*, 3/4 (1963) 301-22. (In Chinese).

This work was undertaken to det. which cellular structure in *S. ricini* synthesizes the fibroin, to study the turnover rate of silk protein, and to correlate protein synthesis with ribonucleic acid (RNA) metabolism. *S. ricini* at 5th instar was employed. Glycine-C^{14} was used in this work. The distribution of C^{14} in the cellular fractions was detected. The posterior silk glands were homogenized and fractionated by centrifugation at various forces into crude (cG), large (lG) and medium sized (mG) granules. The supernatant was treated with M HOAc to pH 5, and precipitation resulted. The precipitate (sG) was separated from the solution (s). Thirty min after glycine-C^{14} was used, most of the C^{14} was present in lG, some in mG, and very little in sG and s. Because mG had a very high specific activity, mG might be the site of the fibroin synthesis. At 6 h C^{14} was found in RNA from the coagulated fibroin. P^{32} was found in RNA, when it was used instead of C^{14}. Both RNA-C^{14} and RNA-P^{32} gave the same biological half-life. This demonstrates that the turnover rate of silk protein is very fast. The kind of RNA in connection with the fibroin synthesis was not given. (CA 61: 1964, 4758h)

255 McGinnis, A.J., Kasting, R. NUTRITION OF THE PALE WESTERN CUTWORM, Agrotis orthogonia Morr. (LEPIDOPTERA: NOCTUIDAE). V. UTILIZATION OF PROTEIN LABELED WITH CARBON-14. J. Nutr. 76, 4 (1962) 333-40.

A diet containing algal protein-U-C^{14} provided a convenient means of studying in vivo protein utilization by larvae of the pale western cutworm, Agrotis orthogonia Morr. Utilization of dietary protein in both 1st- and 5th-instar larvae was found to be quantitatively significant. This technique avoids the difficulty of enzyme extraction artifacts and has particular application to organisms that are too small to permit investigation by classical methods. (Auth.)

256 Miura, Y., Ito, H., Tanaka, S., Momose, K., Sunaga, K., Moriyama, A. THE PROTEIN SYNTHESIS IN SILK GLANDS. I. TRANSFER OF RADIOACTIVITY FROM PRELABELED CELL DEBRIS TO PARTICULATE FRACTIONS IN THE CELL-FREE SYSTEMS OF THE POSTERIOR SILK GLAND. J. Biochem., Tokyo 50 (1961) 458-66.

Glycine-2-C^{14} was injected in Bombyx mori or was incubated with silk gland mince in 0.4 M sucrose at pH 7.4-7.6, 37°C. The silk gland or its mince was homogenized and subjected to differential centrifugations at 700, 14000, and 8500 (pH 6.1) and 8500 g (pH 4.9) to separate cell debris (CD), large particles (LP), small particles (SP), incorporating enzyme (I), and amino acid-activating enzyme (II) fractions, respectively Carbon-14 transfer from C^{14}-labelled CD to other fractions was examined by the cell-free system containing adenosine and guanosine triphosphates, phosphorcreatine, creatine kinase, $MgCl_2$, KCl, sucrose, amino acids, all the gland fractions, and C^{14}-labelled CD at pH 7.4 - 7.6. Carbon-14 of CD was dominantly transferred to the protein and polypeptide moieties of LP, and to a lesser extent, to these compounds, in SP. II was unessential and could be omitted from the above cell-free system. In vivo incorporation of glycine-2-C^{14} was CD > LP $\gg$ SP $\gg$ I $\gg$ II; C^{14} was predominant in the protein part of CD, LP, and SP and was very low (< 0.5% of the protein) in the lipid or phosphatido-peptide parts. (CA 56: 1962, 10721e)

257 Miura, Y., Ito, H., Tanaka, S., Momose, K., Sunaga, K., Moriyama, A. THE PROTEIN SYNTHESIS IN SILK GLANDS. II. EFFECTS OF INHIBITORS ON TRANSFER OF RADIOACTIVITY AND ROLE OF LIPID FRACTION IN PROTEIN SYNTHESIS. J. Biochem., Tokyo 50 (1961) 526-32.

The C^{14}-transferring potency of the cell-free system (cf. preceding abstr.) was inactivated by ribonuclease and deoxyribonuclease digestion, and water of deoxycholate washing, but it was not affected by 10^{-4} M chloramphenicol, 2,4-dinitrophenol, or 10^{-5} M N mustard. The inactivation treatments did not change C^{14} radioactivity of the protein fraction of CD, except for the case of demineralized water-washing. It is concluded that: the C^{14}-precursor(s) in CD is not an integral part of CD-protein, but may be peptidelike substances attached to CD consisting of nuclear debris and cell membrane fragments as demonstrated microscopically; the lipid fraction is not associated with the precursor(s), but simply mediates the transfer reaction. (CA 57: 1962, 103699g)

258 Miura, Y., Ito, H., Tanaka, S., Momose, K., Sunaga, K., Araki, E. PROTEIN SYNTHESIS IN SILK GLANDS. III. RADIOACTIVE SUBSTANCES IN CELL DEBRIS. J. Biochem., Tokyo 51 (1962) 267-73.

Incorporation of glycine-2-C^{14} (I) into the cell debris fraction (II) of silk gland is catalyzed by the enzyme fraction, E_{2+3} (cf. loc. cit.), which is accelerated by the simultaneous addition of 18 natural amino acids. A partial hydrolysis of C^{14}-labelled II yields C^{14}-peptide-nucleic acid complex (III), containing I as a sole C^{14}-substance. Neither phospholipid nor phosphatidoprotein of II is enriched by C^{14}. The particulate fraction of the silk gland cell (cf. loc. cit.) mediates effectively C^{14} incorporation to the protein fraction of II from III-C^{14}. A slight yield of protein-C^{14} from I occurring in II is processed by the particulate enzyme(s) adhered to the cell membrane contaminated in II. III is very likely a precursor of I incorporation to protein. (CA 57: 1962, 10369f)

259 Miura, Y., Ito, H., Momose, K., Sunaga, K., Ikeda, K. STUDIES ON THE PROTEIN SYNTHESIS IN SILKGLANDS. IV. INCORPORATION OF LABELED GLYCINE INTO THE VESICULAR PROTEIN BY POSTERIOR SILKGLANDS. J. Biochem., Tokyo 52, 5 (1962) 333-42. (In English).

Posterior silk glands from Bombyx mori L. (obtained on the 6th or 7th day of the 5th instar) were incubated with glycine-2-C^{14}, minced and subjected to density gradient fractionation. Mitochondria were effectively separated from the particle fraction which actively incorporates amino acids into protein. The amino-acid-incorporating particles were found to have high lipid but relatively low RNA content. Electron microscopy showed the particles to consist mainly of might smooth-surfaced endoplasmic reticulum. The possibility that the particle might be a secretory granule of fibroin is considered. The supply of energy from oxidative phosphorylations is assumed to be of primary importance for fibroin synthesis. Oxidative phosphorylation of the particles with succinate and glycine-2-C^{14} incorporation into the particle proteins were inhibited by 10^{-4} M 2,4-dinitrophenol, but not by cloramphenicol or gramicidin-S. The role of nuclei in fibroin synthesis and fibroin secretion in the posterior silk glands is discussed.

260 Momose, K. STUDIES ON THE INCORPORATION OF LABELED GLYCINE INTO THE PROTEIN OF THE MITOCHONDRIA-LIKE PARTICLES BY POSTERIOR SILK GLANDS. Seikagaku Zasshi 34 (1962) 199-204. (In Japanese).

Slices of posterior silk glands incubated with glycine-2-C^{14} (I) at 37° (0.4M sucrose buffer, pH 7.8) were homogenized by a Waring blendor and the resulting homogenates were separated by a density gradient centrifugation. Incorporation of I was highest in large particles precipitated at 14000 g at 30 min) containing mitochondria. But among 5 fractions of these large particles, a fraction highest in the specific radioactivity was lowest in ribonucleic acid content and low in succinic dehydrogenase activity, indicating the site of fibroin protein at "secretion particles" in glands. 2,4-Dinitrophenol strongly inhibited the incorporation of I into the large particles. Thus, the synthesis of fibroin protein requires the supply of energy by oxidative phosphorylation. Chloramphenicol and gramicidin-S stimulated the incorporation of I into the large particles. (CA 57: 1962, 6453h)

261 Muramatsu, M., Shimura, K., Nagayama, H. STUDIES ON THE BIOSYNTHESIS OF GLYCINE IN THE SILKWORM. I. FORMATION OF GLYCINE FROM SERINE. J. Biochem., Tokyo 49 (1961) 55-8.

Serine-1-C^{14} injected to Bombyx mori at 5th instar stage was incorporated into glycine of body fluid and in a later stage, into glycine of the protein of posterior silkgland. A direct conversion of serine to glycine is suggested from an exclusive labelling of carboxyl C of glycine. (CA 55: 1961, 13689d)

262 Muramatsu, M., Shimura, K. STUDIES ON THE BIOSYNTHESIS OF GLYCINE IN THE SILKWORM. II. CONVERSION OF GLYOXYLIC ACID TO GLYCINE IN THE INTACT SILKWORM. J. Biochem., Tokyo 52, 4 (1962) 297-301.

Following the injection of glyoxylic acid-1,2-C^{14} the C^{14}-radioactivity was predominantly recovered in the glycine and serine residues of the protein synthesized in posterior silk-gland. A minor part of C^{14} was detected in respiratory CO_2. When C^{14}-glycine was administered any appreciable amount of C^{14} was recovered in glyoxylic acid of body fluid or respiratory CO_2. (BA 43: 1963, 21239)

263 Nigon, V., Nonnenmacher, J. THE INCORPORATION OF TRITIATED THYMIDINE IN THE COURSE OF OVOGENESIS IN Drosophila. Devl Biol. 3 (1961) 210-24.

3-d-old Drosophila were injected in the abdomen with 0.3 - 0.6 μc of tritiated thymidine. Ovaries were collected 1 h later and distribution of radioactivity observed. Maximum incorporation of radioactivity corresponded to the most actively growing period of the oöcyst. Thymidine uptake occurred in structures sensitive to the action of deoxyribonuclease and ribonuclease. As a possible explanation of the data the existence of a metabolically active deoxyribonucleic acid fraction was discussed. (CA 56: 1962, 1849c)

264 Okamoto, S., Okada, T., Kyo, S. THE MECHANISM OF FIBROIN BIOSYNTHESIS BASED ON ITS CHEMICAL STRUCTURE. I. THE PARTIAL HYDROLYZATES OF C^{14}-LABELLED FIBROIN. Nippon Nogei Kagaku Kaishi 37, 3 (1963) 163-6. (In Japanese).

The present work was carried out to clarify whether fibroin biosynthesis in the silkworm's posterior silk glands proceeds by a stepwise mechanism or by simultaneous conjugation of component amino acids. Labelled fibroin was prepared by injecting 1 μc glycine-1-C^{14}. 2 h after the injection fibroin-C^{14} was separated from the posterior gland, and partially hydrolyzed with concentrated HCl at 40° for 18 h. From the hydrolyzate, 17 peptides were isolated by repeated paper chromatographic procedures. Their specific radioactivities were counted, and their amino acid components were identified by paper chromatography. The peptides differed widely in their specific radioactivities. Autoradiography was applied to the paper chromatograms of hydrolyzates of each peptide. Some peptides containing glycine or serine residues had high radioactivity, but others displayed no activity. Fibroin is probably labelled nonuniformly, and fibroin biosynthesis in silk glands occurs by a stepwise mechanism. (From EM II 17, 1: 1964, abstr. 329)

265 Okamoto, S., Okada, T. THE MECHANISM OF FIBROIN BIOSYNTHESIS BASED ON ITS CHEMICAL STRUCTURE. II. THE FORMATION OF CRYSTALLINE AND NONCRYSTALLINE PARTS OF FIBROIN. Nippon Nogei Kagaku Kaishi 37, 3 (1963) 167-71. (In Japanese).

C^{14}-labelled fibroin was prepared by injecting or dosing glycine-1-C^{14} to silkworms. Crystalline and non-crystalline fractions were separated by protease such as trypsin or pancreation from the labelled fibroin solution. Specific radioactivity of each fraction was counted for various time intervals after the injection, That of the N- and non-N-terminal amino acids of the 2 fractions was also measured. The crystalline fraction had higher radioactivity generally, but lower at its N-terminal residue as compared with the non-crystalline fraction. This difference appeared most distinctly at 2 h after the injection. The crystalline fraction, so far as ascertained in the present experimental conditions, is synthesized first, and then the formation of the non-crystalline fraction follows it. There was no doubt about the non-uniform mode of labelling of each fraction of fibroin, judging from the values of radioactivity of the N- and non-N-terminal residues. (From EM II 17, 1: 1964, abstr. 330)

266 Price, G.M. SOME ASPECTS OF AMINO ACID METABOLISM IN THE ADULT HOUSEFLY, Musca domestica. Biochem. J. 80 (1961) 420-8.

Extracts from whole flies, heads and haemolymph were analysed, following injection of [2-C^{14}] acetate into 5-6 d old Musca domestica L. The experimental procedures are described. Location of amino acids was studied by a) chemical, b) radiometric, and c) radioautographic methods. Aspartic acid and glutamic acid were concentrated in the tissues of the fly and hardly detectable in the haemolymph. γ-Aminobutyric acid was detectable only in the head extracts. After injection of the fly with [2-C^{14}]acetate, α-alanine, aspartic acid, γ-aminobutyric acid, glutamic acid, glutamine and proline became labelled. Labelled α-alanine, aspartic acid, glutamic acid and proline were identified in a protein hydrolystate from 'labelled flies. Glutamic-alanine- and glutamic-aspartic acid-transaminase activity was demonstrated in sarcosomes isolated from flight-muscle, but these two enzyme systems were not detectable in haemolymph. - Other amino acids identified were β-alanine, arginine, glycine, leucine, lysine, methionine sulphoxide, phenylalanine, serine, taurine, tyrosine and valine.

267 Price, G.M., Moriya, S. EFFECTS OF ANOXIA ON THE METABOLISM OF AMINO ACIDS BY THE ADULT HOUSEFLY (Musca domestica) IN VIVO. Biochem. J. 84 (1962) 98P.

4-d-old houseflies were injected with [2-C^{14}]acetate and left in air for 1 h. One group was killed immediately in liquid nitrogen (zero-time control), a second (aerobic) after being left in air for another 2 h, and a third group (anoxic) after 2 h in O_2-free nitrogen. At least 8 C^{14}-labelled intermediates, other than free amino acids, were detectable in the ethanol extracts of anoxic flies (amongst them glutathione, fumarate, lactate, malate and succinate, the largest amount of C^{14}-activity being found in succinate). Specific radioactivity measurements of the protein amino acids showed that in the aerobic flies free C^{14}-amino acid had been incorporated into protein over the 2-h-period, whereas in the anoxic flies there had not been any incorporation.

268 Price, G.M. THE EFFECTS OF ANOXIA ON METABOLISM IN THE ADULT HOUSEFLY Musca domestica. Biochem. J. 86 (1963) 372-8.

Houseflies were injected with [2-C^{14}] acetate and were left in air for 1 h. Some were then killed, some were left in air for a further 1 h or 2 h, and others were put into oxygen-free N_2 for 1 h or 2 h. In the aerobic flies C^{14}-labelled α-alanine, aspartate, glutamate, glutamine, proline, γ-amino-butyrate, fumarate, malate, α-oxoglutarate, pyruvate, succinate, and glutathione were present. In the anoxic flies all the above intermediates were present as well as C^{14}-labelled lactate and 3 other unidentified C^{14}-labelled intermediates. In the anoxic flies there was an increase in the concentration of α-alanine, but there was a fall in the concentrations of aspartate and of glutamine. The concentration of pyruvate rose during the first 30 min of anoxia but later returned to its original value. There was a rise in the C^{14} activity of lactate, of succinate and of γ-aminobutyrate. In the aerobic flies the specific activity of the protein amino acids increased whereas in the anoxic flies their specific activity either decreased or remained the same. (Auth.)

269* Rabinovitch, M., Vugman, I. AUTORADIOGRAPHIC OBSERVATIONS ON THE SILK GLANDS OF Bombyx mori. J. biophys. biochem. Cytol. 6 (1959) 293-4.

Glycine-1-C^{14} was administered to B. mori larvae (5th instar) and its incorporation in the silk glands followed autoradiographically. After 15 and 30 min the autoradiographs showed strong and diffuse activity in the cell cytoplasm. At 1 h it was mainly found over the cell apex and newly formed secreted material, At 12 and 24 h the activity was localized mainly in the material secreted into the lumen. (Auth. summary)

270 Раменская, Г.П. АВТОРАДИОГРАФИЧЕСКОЕ ИССЛЕДОВАНИЕ БИОСИНТЕЗА БЕЛКА В КЛЕТКАХ ФИБРОИНОВОГО ОТДЕЛА ШЕЛКООТДЕЛИТЕЛЬНОЙ ЖЕЛЕЗЫ ТУТОВОГО ШЕЛКОПРЯДА (Bombyx mori). Ж. общ. Биол. 23, 5 (1962) 391-3.

Ramenskaya, G.P. AN AUTORADIOGRAPHIC STUDY OF PROTEIN SYNTHESIS IN THE CELLS OF THE FIBROIN PORTION OF THE SILK GLAND IN Bombyx mori. Zh. obshch. Biol. 23, 5 (1962) 391-3.

Radioautography of transverse sections of the silk gland, 5 min - 48 h after injection of 0.07 - 0.33 μc of glycine-C^{14} into the haemolymph of larvae on the 6th day of the 5th stage, showed that during the 1st hour the radioactivity is incorporated mainly into the cytoplasm, with increasing amounts in the nuclei and a gradual concentration of radioactivity in the internal membrane of the gland. After 2 h radioactivity also appeared in the secretion, increasing with time up to 9 h and accumulating in the glandular lumen. After 2 d little radioactivity remained. The results indicate that fibroin or its precursors are first synthesized in the cytoplasm. The subsequent appearance of radioactivity in the nuclei may be due either to simultaneous fibroin synthesis in the nuclei, or to penetration of secreted material from the cytoplasm. (From BA 42: 1963, 3906)

271* Rembold, H., Hanser, G. ROYAL JELLY OF THE HONEYBEE. VI. METABOLISM OF BIOPTERINS IN THE HONEYBEE. Hoppe-Seyl. Z. 319 (1960) 213-9.

A synthesis of biopterin-2-C^{14} is described. The labelled compound with a specific activity of 2 mc/mM was fed to 2-d-old queen bee larvae in the hive and to corresponding worker larvae in a thermostat. In both cases most of the radioactivity was excreted before pupation, and the remainder was present in equal concentrations in the pupa and imago. The absorbed biopterin can be demonstrated unchanged in all stages of development and undergoes no significant conversion to other fluorescent compounds. In the excrement other fluorescent materials are presented besides biopterin. Small amounts of other Crithidia growth substances, together with biopterin, were found when extracts of both queen and worker larvae were separated by paper chromatography. (CA 55: 1961, 11687d)

272* Rizki, M.T.M., Rizki, R.M. FUNCTIONAL SIGNIFICANCE OF THE CRYSTAL CELLS IN THE LARVA OF Drosophila melanogaster. J. biophys. biochem. Cytol. 5 (1959) 235-40.

Larvae fed tyrosine-C^{14} showed that in the crystal cells radioactivity was restricted to the crystal inclusions and was significantly higher than that found in other types of haemocytes. When samples of blood cells were incubated with 3-(3,4-dihydroxyphenyl) alanine, the extra-crystalline cytoplasm became blackened while the crystals remained colorless. These observations are consistent with the hypothesis that the substrate is localized in the crystal inclusions, whereas the enzyme is found in the surrounding cytoplasm. (CA 53: 1959, 16401h)

273 Russo-Caia, S. FAT BODY INSECTS. AUTORADIOGRAPHIC OBSERVATIONS ON INCORPORATION OF ADENINE-C^{14} AND OROTIC ACID-C^{14} IN LARVAL TROPHOCYTES OF Musca domestica. R.C. Ist. Sci. Camerino 4,3 (1963) 216-28. (In Italian).

Nuclei of fat-body cells are labelled 10 min after injection of title compounds. Two hours later labelling is more evident mainly in nucleus; 6 h later several cytoplasmic tracks are evident. Radioactivity is related to ribonucleoproteins identified in fat-body cells with Pyronine-methyl green, and toluidine blue. Radioactivity disappears after ribonuclease and perchloric acid treatment. Results suggest occurrence of synthesis of ribonucleic acid and its transfer from nucleus to cytoplasm in fat-body cells of larvae. (CA 60: 1964, 16255e)

274 Самарина, О.П. ВКЛЮЧЕНИЕ ГЛИЦИНА-1-C^{14} В БЕЛКИ ФРАКЦИЙ ГОМОГЕНАТА ШЕЛКООТДЕЛИТЕЛЬНОЙ ЖЕЛЕЗЫ ТУТОВОГО ШЕЛКОПРЯДА Bombyx mori L. Биохимия 27, 5 (1962) 814-21.

Samarina, O.P. GLYCINE-1-C^{14} INCORPORATION INTO THE PROTEINS OF FRACTIONS OF SILK GLAND HOMOGENATE OF Bombyx mori L. Biokhimiya 27, 5 (1962) 814-21. Available in English in Biochemistry (Translation of Biokhimiya) 27, 5 (1963) 690-5.

The homogenate of the silk gland of silk worm larvae in 5th instar was divided by differential centrifugation into 5 fractions. The particulate fractions contained large amounts of RNA. The highest concentration of RNA was found in the 4th fraction, sedimented at 100 000 g. Nuclear material sedimented almost completely in the 1st fraction. In vivo as well as in vitro glycine-C^{14} incorporates in a very short time into the proteins of the 1st 3, especially of the 2nd and the 3rd fractions. In chase experiments with non-radioactive glycine after preliminary incubation in vivo or in vitro with glycine-C^{14} radioactive label was transferred to the protein of the 4th and 5th fractions. Incorporation of glycine was inhibited to almost the same extent in each fraction by RNase, chloramphenicol and to a lesser extent - by DNase or protamin. The results obtained are discussed in connection with the participation of various cell structures in protein biosynthesis in the silk gland. (Auth.: BA 43, 1963, 8280)

275 Schmialek, P. FORMATION OF JUVENILE HORMONES IN WILD SILK SPINNERS. Z. Naturf. 18b, 6 (1963) 462-5.

The juvenile hormone (CA 57, 7751f) in combined MeOH and C_6H_6 extracts of Samia cynthia was identical in its thin-layer chromatography properties to farnesol (I) and farnesal (II). Mevalonate-2-C^{14} was incorporated by live insects into substances characterized by chromatography as I, II, and neurolidol. Isolated I and II injected into Tenebrio species insects produced allatum-hormone activity. (CA 59: 1963, 10504c)

276 Seiichi, S., Shimura, K. ELECTRON MICROSCOPIC AND SOME BIOCHEMICAL STUDIES ON THE CELL FRACTIONS OF SILK GLANDS. Tohoku J. agric. Res. 12 (1961) 253-60.

The highest specific activities of acid phosphatase and acid ribonuclease in homogenates of silkworm silk glands were found in the large microsomal fraction while similar total activities but lower specific activities of both enzymes were found in the mitochondrial fraction. Electron micrographs revealed microsomal structures in all particulate fractions including the cell debris fraction. The large microsomal fraction also contained electron-dense granules thought to be indicative of the lysosomal nature of this fraction. The small microsomal fraction consisted of small microsomal vesicles and free Palade particles. Subfractionation of each cell fraction with Na deoxycholate following incubation with glycine-1-C^{14} (I) showed that I was incorporated predominantly into the insoluble proteins. These proteins contained most of the ribonucleic acid of each subfraction and more glycine than either the whole fraction or the soluble subfraction. It is suggested that fibroinlike materials exist, perhaps in the intracisternal areas like the intracisternal granules of exocrine cells of pancreas, which become insoluble during the subfractionation process analogous to the coagulation of fibroin. (CA 56: 1962, 12097c)

277 Seiichi, S., Shimura, K. BIOSYNTHESIS OF SILK FIBROIN. III. IN VIVO INCORPORATION OF GLYCINE-C^{14} INTO PROTEINS OF POSTERIOR SILK GLAND FRACTIONS. J. Biochem., Tokyo 49 (1961) 69-75.

The homogenate of posterior silk gland with 0.35 M sucrose was fractionated to R(residue), M(mitochondrium), L(large microsomal granules), S(small microsomal granules), and soluble supernatant by differential centrifugations at 1000, 3900, 15 000 and 105 000 x g, successively. Ribonucleic acid (RNA)-containing microsomes were released from R by deoxycholate treatment. RNA was highest in S, and lower in M and L, but not present in soluble fraction. M and L fractions were rich in phospholipides. R contained a large amount of fibroin. The 4 sedimenting fractions were examined for C^{14} following the injection of glycine-1-C^{14}. R showed an initial, temporary rise of C^{14} incorporation, presumably to its microsomal moiety, and later incorporation of C^{14} to fibroin of R proceeded when C^{14} radioactivity of L, M, and S fractions were decaying. Microsomes in heterogeneous states in R, M, L, and S fractions play a role in taking up glycine for protein synthesis. (CA 55: 1961, 12669i)

278 Sekeris, C.E., Karlson, P. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. VII. DER KATABOLISCHE ABBAU DES TYROSINS UND DIE BIOGENESE DER SKLEROTISIERUNGSSUBSTANZ, N-ACETYL-DOPAMIN. (Tyrosine metabolism of insects. VII. The catabolic degradation of tyrosine and the biogenesis of the sclerotizing agent N-acetyldopamine). Biochem. biophys. Acta 62 (1962) 103-13. (In German, with English summary).

In early 3rd-instar Calliphora larvae, tyrosine is transaminated to p-hydroxyphenylpyruvic acid and further metabolized to p-hydroxyphenylpropionic acid. The transaminase is a pyridoxal phosphate-dependent enzyme and can transfer the amino group to α-ketoglutarate. In the late 3rd instar (just before pupation), tyrosine is hydroxylated to DOPA. The action of a DOPA decarboxylase was further demonstrated; in vivo, the dopamine formed is rapidly acetylated to N-acetyldopamine. This metabolite serves as sclerotizing agent in puparium formation. The findings are discussed in connection with the mode of action of the metamorphosis hormone, ecdysone. The following radioactive preparations were used: generally labelled L-[C^{14}]tyrosine, DL-[2-C^{14}]DOPA, [2-C^{14}]tyramine, and [2'-C^{14}]dopamine.

279 Sekeris, C.E. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. XII. REINIGUNG, EIGENSCHAFTEN UND SUBSTRATSPEZIFITÄT DER DOPA-DECARBOXYLASE. (Tyrosine metabolism in insects. XII. The purification, properties, and substrate specificity of Dopa-decarboxylase). Hoppe-Seyl. Z. 332 (1963) 70-8. (In German, with English summary)

Determination of enzyme activity by a radiochemical method is not only more specific but at least 5 times as sensitive as manometric measurements. A C^{14}-labelled substrate was used. A 360 fold purification of the Dopa-decarboxylase from Calliphora erythrocephala larvae was achieved by fractionation with ammonium sulphate and chromatography on DEAE-cellulose. The purified enzyme is very labile and requires pyridoxal phosphate and Fe ions. Carbonyl reagents and amines, particularly N-acetyl-dopamine, inhibit the decarboxylation. Dopa is more readily decarboxylated than 5-hydroxy-tryptophan or 5,6-dihydroxy-tryptophan. Phenylalanine, tyrosine, tryptophan and histidine are not attacked. The enzyme can be regarded as a specific Dopa-decarboxylase.

280 Sekeris, C.E. TYROSINE METABOLISM IN THE BLOWFLY, Calliphora erythrocephala. p. 281-7 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Sclerotization is due to interaction of o-quinones with cuticle proteins. It has been shown by means of C^{14}-labelled amino acids that N-acetyldopamine is the immediate precursor of the sclerotizing quinones in Calliphora erythrocephala. The intermediate steps in the biosynthesis of N-acetyldopamine are hydroxylation of tyrosine to dopa, decarboxylation of dopa to dopamine and N-acetylation of dopamine to N-acetyldopamine.. This metabolic pathway of tyrosine is followed only in the final-instar larvae; early 3rd-instar larvae catabolize tyrosine by transamination to p-hydroxyphenylpyruvic acid and reduction to p-hydroxyphenyllactic and -propionic acid. The metabolic shift from transamination to hydroxylation and decarboxylation is brought about by the hormone of the prothoracic gland, ecdysone, and can be inhibited by ligation or destruction of the ring gland. Injection of ecdysone into the ligated animals leads to activation of the dopadecarboxylase within 10-14 h. The first action of the hormone produces the puffing phenomenon in chromosomes. The working hypothesis is that the hormone interacting with the genetic material leads to stimulation of the synthesis of specific (messenger-) RNA which is transferred to the cytoplasm and produces enzyme proteins. (Essentially auth.)

281* Shigematsu, A. INCORPORATION OF C^{14}-AMINO ACIDS INTO PROTEIN AND LIPID FRACTIONS OF SILKWORMS. Seikagaku Zasshi 32 (1960) 519-24.

Shortly after the injection of C^{14}-labelled amino acids into Bombyx mori, radioactivity was incorporated into protein fractions of silk gland, then fibroin became radioactive. At about the same time lipoproteins (I) of the silk gland became radioactive. The rate of incorporation of leucine, phenylalanine, and tryptophan into I was ~20% of that incorporated into protein, and there was a proportional relation between the incorporation of amino acids into these 2 fractions. Amino acids were incorporated into the fat body of silkworms, and also into the lipid-soluble fraction of this organ, but the pattern was markedly different from that into the silk gland. Incorporation of glycine-C^{14} into the fat body was low, whereas that of leucine was high. (CA 60: 1964, 4507h)

282 Shigematsu, H., Koyasako, T. KINETICS OF SYNTHESIS OF FIBROIN IN THE POSTERIOR DIVISION OF THE SILKGLAND OF THE SILKWORM, Bombyx mori. Nature, Lond. 195 (1962) 501-2.

The synthesis of fibroin and secretion in the posterior division of the silk gland can be divided into 3 phases: the absorption of amino acids, the synthesis of fibroin, and its secretion. An attempt was made to show that the complex reaction is effected by an enzyme system by studying the incorporation of C^{14}-labelled glycine into fibroin in vitro. The co-existence of amino acids other than glycine showed alanine to have no marked effect on the incorporation of C^{14}-labelled glycine into fibroin, serine to retard the reaction and tyrosine to accelerate it. (CA 57: 1962, 10369i)

283 Shigematsu, H. SILKWORM DEVELOPMENT AND SILK PRODUCTION unpublished (cited on p. 296 in Annu. Rev. Ent. 8 (1963)). ---"Found that 59% of given C^{14}-glycine enters fibroin in 8 h, 32% of which passes through fatty tissues and the alimentary canal".

284* Shimura, K., Fukai, H., Sati, J., Saeki, R. NONUNIFORM LABELING OF THE SILK FIBROIN SYNTHESIZED IN VIVO. J. Biochem., Tokyo 43 (1956) 101-2.

After the administration of $CH_2NH_2C^{14}$-O_2H (5 mg 1.2 x 10^4 cpm) to each silkworm larva on the 3rd-4th day of the 5th instar, silk fibroin (I) is isolated from posterior gland, by washings with 0.14 M and M NaCl, distilled water, EtOH, and ether in order, and the radioactivity of I is determined. The labelled glycine is shown to be incorporated non-uniformly, but it is present predominantly in N-terminal amino acids of I molecule. (CA 50: 1956, 10286a)

285 Simmons, J.R. STUDIES OF AMINO ACID INCORPORATION IN THE LARVAE OF Drosophila melanogaster. Thesis. California Inst. of Tech., Pasadena. Biology Div. 1961.

C^{14}-labelled amino acids were injected into the haemolymph of larvae. The resulting pattern of incorporation was investigated by direct paper chromatography of the injected larvae and by column fractionation of larval extracts. Injected amino acids were rapidly incorporated into a large number of components, many of them peptides, others containing non-amino acid constituents of unknown nature. A major portion of the amino acids in insect haemolymph occur in bound form. In order to obtain larger amounts of amino acids in non-protein-bound forms, attemps were made to inhibit protein synthesis. Of the treatments tested only Metrazol and chlorpromazine were effective in reducing protein synthesis and this reduction was accompanied by a decrease in amount in all radioactive metabolic product. The possible significance of this reduction is discussed. Material containing bound C^{14}-glutamic acid was isolated from larval extracts and reinjected. Radioactivity from the injected material was found to be incorporated into the protein of the larvae but at a slower rate than was the free amino acid. The implications are discussed.

286 Simmons, J.R., Mitchell, H.K. METABOLISM OF PEPTIDES IN Drosophila. p.147-55 in "Amino Acid Pools, Distribution, Formation and Function of Free Amino Acids. Proceedings of a Symposium on Free Amino Acids held at the City of Hope Medical Centre, Duarte, Calif., U.S.A., May 1961". Holden, J.T., Ed. Amsterdam, Elsevier Publishing Company. 1962.

By means of a special apparatus large numbers of larvae could be injected with as little as 0.05 µl, with an error of ca. ± 25%. For studies of incorporation of amino acids in time series, larvae were injected and washed, placed on filter paper and squashed. n-Propanol-1% aqueous ammonia (3:1) was used mostly for chromatography. Radioactive (C^{14}-labelled) L-glutamic acid (4 µc/15µl), L-leucine (10 µc/20µl) and L-valine (10 µc/20 µl) were used, isolated fractions being reinjected in some experiments. It is concluded that the injected amino acids are very rapidly incorporated into peptides of various sizes. Subsequently they enter into proteins, but the mechanisms of synthesis are not understood. In initial stages, mixed peptides containing C^{14}-labelled glutamic acid are incorporated into proteins at about the same rate as glutamic acid itself but whether the peptides are incorporated directly or are first hydrolyzed remains an open question. Glutamic acid (glycine, alanine and aspartic acid behave similarly) goes very rapidly into peptides and relatively slowly into proteins. It is widely distributed in bound form (peptides). Leucine and valine, however, which are amino acids essential to Drosophila, appear in relatively few peptides more directly and rapidly in proteins. Chloramphenicol and p-fluorophenylalanine had no influence on the rate of incorporation of amino acids into proteins in this in vivo system, even when saturated solutions were injected. So far, no inhibitors have been found which specifically inhibit protein synthesis in the larvae.

287* Sirlin, J.L., Knight, G.R. PATTERN OF PROTEIN SULFUR AFTER FEULGEN HYDROLYSIS IN THE SALIVARY GLAND CHROMOSOMES OF Drosophila melanogaster. Chromosoma 9 (1958) 119-59.

The residual non-histone protein in the chromosomes was studied by means of high-resolution autoradiography after feeding with methionine-S^{35} throughout larval life. (From EM 14, I: 1960, 3962)

288* Sirlin, J.L., Knight, G.R. CHROMOSOMAL SYNTHESES OF PROTEIN. Exp. Cell. Res. 19 (1960) 210-19.

Drosophila melanogaster and D. virilis were used. Salivary chromosomes labelled in vivo for short times with methionine-S^{35} or C^{14} and leucine-H^3 show a pattern of labelling that resembles qualitatively that in chromosomes labelled throughout larval life with methionine-S^{35}. The autoradiographs of discrete chromosomal regions, on which that pattern is based, are not displaced after withdrawal of tracer or effaced by treatment with KCN as an unfolding agent. It is concluded that the pattern of labelling originally described represents a pattern of localized protein syntheses superimposed on the protein backbone of the chromosome. Several possible aspects of this pattern are discussed. (Essentially auth. summary)

289 Skinner, D.M. INCORPORATION OF LABELED VALINE INTO THE PROTEINS OF THE Cecropia SILKWORM. Biol. Bull. 125, 1 (1963) 165-76.

Brainless, diapausing pupae of Platysamia cecropia were each injected with 2.6 µc valine-1-C^{14}. Various tissues were removed from which the proteins were precipitated, washed, and plated, and the radioactivity measured. The rates of incorporation of proteins into the tissues were reported as specific activities representing cpm/mg protein. In 16 animals the specific activity in blood, fat body, epidermis, and midgut 12 h after injection of valine-1-C^{14} was 0, 40, 100, and 280 respectively. In 31 animals injected with similar doses of labelled valine on the 2nd or 3rd day after initiation of adult development, at the end of 12 h after injection, the specific activity in blood, fat body, gut, and epidermis was 100, 300, 825, and 1425, respectively. There was a further increase in incorporation in some tissues by the 17th day of development. The specific activity of eggs, epidermis, blood, fat body, and muscle at 5 h after injection was 1600, 1600, 900, 175, and 1200, respectively. The blood proteins were 15-16 times more highly labelled than those of 2- or 3-d-old animals. Fat body showed little ability to incorporate amino acids. When animals were injured by removal of the cuticle in the facial region, the uptake of labelled valine by blood, fat body, gut, and epithelium was greatly increased. Injections of 0.04 ml 10% MeOH in insect Ringer's solution, and 4000 Calliphora units of purified ecdysone in 0.04 ml 10% MeOH in insect Ringer's solution both greatly increased the amount of labelled amino acid incorporated into protein. Ecdysone release has 2 effects on a diapausing animal: to increase metabolism, and to reroute metabolic pathways toward growth and differentiation. Injury can duplicate the first effect but not the 2nd. The radioactivity of subcellular fractions of thoracic muscle was measured in 12 animals on the 17th and 21st day of adult development. Two hours after injection of 2.6 µc valine-1-C^{14}, the specific activities in 17-d-old animals were reported as 911, 766, 678, and 604 for microsomes, myofibrils, soluble cell fraction, and sarcosomes, respectively. For the same cell fractions in 21-d-old animals, the specific activities were 566, 320, 385, and 343, respectively. Hence, amino acids were incorporated into all cell fractions. (CA 59: 1963, 14336b)

290 Stevenson, E., Wyatt, G.R. THE METABOLISM OF SILK MOTH TISSUES. I. INCORPORATION OF LEUCINE INTO PROTEIN. Arch. Biochem. Biophys. 99, 1 (1962) 65-71.

Fat body tissue from larvae and pupae of saturniid silkmoths* was incubated with leucine-1-C^{14}, and incorporation into toal protein was measured. Midgut tissue was also used in a few experiments. In a medium of salts and amino acids based on the composition of silkworm haemolymph, incorporation by fat body is linear for at least 6 h, whereas some media give declining rates, and in severely hypotonic media, or with homogenates, incorporation is virtually abolished. In fat body from mature larvae the rate of amino acid incorporation is high; in tissue from diapausing pupae it has fallen to about 0.3% of the larval rate; and by an early stage of adult development it has risen again to about 10% of the larval rate. The activity of fat body and midgut also rises after integumentary injury to diapausing pupae. In fat body, the effect on amino acid incorporation was first evident in tissue taken 14 h after the injury; by 7 d it had become maximal (50-70 times the pre-injury rate); and thereafter the activity declined toward the pre-injury rate (Auth.)

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* (Hyalophora cecropia, Antheraea polyphemus and Samia cynthia)

291 Strong, F.E., Sakamoto, S.S. SOME AMINO ACID REQUIREMENTS OF THE GREEN PEACH APHID, Myzus persicae (Sulzer), DETERMINED WITH GLUCOSE-U-C^{14}. J. Insect Physiol. 9, 6 (1963) 875-9.

After feeding through a membrane on a solution of glucose-U-C^{14}, M. persicae was found to synthesize alanine, aspartic acid, serine, glutamic acid, glycine, cystine, and two unidentified amino acids. Asparagine, recovered as aspartic acid, was also synthesized. Threonine, valine, leucine, isoleucine, lysine, phenylalanine, methionine, and arginine were not synthesized to any appreciable extent and are considered to be nutritionally essential. Tyrosine was not synthesized and has been classified as essential pending further investigations to elucidate a phenylalanine to tyrosine synthesis. (Auth.)

292 Suto, S., Shimura, K. STUDIES ON THE BIOSYNTHESIS OF SILK FIBROIN. III. IN VIVO INCORPORATION OF GLYCINE-C^{14} INTO PROTEINS OF POSTERIOR SILK GLAND FRACTIONS. J. Biochem., Tokyo 49 (1961) 69-75.

By differential centrifugation at 1000, 3900, 15000, and 105000 g successively the homogenate of posterior silkgland in 0.35 M sucrose was fractionated into R(residue), M(mitochondria), L(large microsomal granules), S(small microsomal granules), and soluble supernatant. RNA-containing microsomes were released from R by deoxycholate treatment. RNA was highest in S, lower in M and L, and absent from the soluble fraction. M and L were rich in phospholipides. R contained a large amount of fibroin. The 4 sedimenting fractions were examined for C^{14} following the injection of glycine-1-C^{14} (specific activity of 0.1 mc/2.2 mg). R showed an initial, temporary rise in C^{14} incorporation, presumably to its microsomal moiety, and later incorporation of C^{14} to fibroin of R proceeded when C^{14} radioactivities of L, M, and S fractions were decaying. Microsomes in heterogeneous states in R, M, L, and S fractions play a role in taking up glycine for protein synthesis. (Parts of this paper were presented at the annual meetings of the Agricultural Chemical Society of Japan, Kyoto 1958 and Tokyo 1959).

293 Suto, S., Shimura, K. ELECTRON MICROSCOPIC AND SOME BIOCHEMICAL STUDIES ON THE CELL FRACTIONS OF SILKGLANDS. Tohoku J. agric. Res. 12, 3 (1961) 253-60. (In English)

Glycine-1-C^{14} (specific activity 4.1 mc/mM) was injected into silkworms (see 292 for details, also of cell fractionation, chemical assays of RNA phosphorus, total N and glycine). Enzyme assays, sample preparation for electron microscopy, and subfractionation of the cellular fractions obtained from homogenizing the posterior silk glands into fractions M, L, and S are described. Following injection of 5000 cpm/silkworm of glycine-1-C^{14} the incorporation of the glycine into the proteins of the subfractions was studied. The initial rise in radioactivity was predominantly in the deoxycholate-insoluble proteins, the radioactivity in the soluble proteins increasing more slowly and linearly. Recoveries of RNA in the insoluble subfractions were 85, 80 and 77% for M, L, and S, respectively. L showed the highest acid phosphatase and ribonuclease activities. Electron microscopic observations revealed microsomal structure in all particulate fractions; L contained electron-dense granules, S small microsomal vesicles and free Palade particles.

294 Suzuka, I., Tanaka, S., Shimura, K. AMINO ACID-ACTIVATING ENZYME FREE FROM PYROPHOSPHATE EXCHANGE. J. Biochem. Tokyo, 49 (1961) 80-2.

Amino acid-activating enzyme (I) is purified from N_8 fraction of posterior silk gland of Bombyx mori by $(NH_4)_2SO_4$ fractionation (0.6 - 0.8 saturation) at pH 8, removing the impurities by centrifuging off the precipitates at pH 4.5, and precipitating (I) at pH 8.0 by 0.8 saturation with $(NH_4)_2SO_4$. (I) activates incorporation of C^{14}-labelled glycine and alanine into deoxycholate-treated particulate of silk gland of B. mori in the presence of the incorporation enzyme and ATP (adenosine triphosphate). Unlike the N_8-fraction, the action of (I) does not accompany any appreciable exchange reaction between P^{32}-labelled pyrophosphate and ATP. (I) is inactivated by heating (95°C for 3 min) and is stable for as long as 3 d at -10°C. Amino acid activation by way of amino acyl adenylate is suspected. (From CA 55: 1961, 13483e)

295 Suzuka, I., Tanaka, S., Shimura, K. STUDIES ON THE BIOSYNTHESIS OF SILK FIBROIN. IV. A PARTICULATE FRACTION CONTROLLING THE SPECIFICITY OF FIBROIN SYNTHESIZED IN A CELL-FREE SYSTEM. J. Biochem. Tokyo 52, 1 (1962) 54-8.

Relative rate of incorporation of glycine-1-C^{14} (I), DL-alanine-1-C^{14} (II) and DL-leucine-1-C^{14} (III) is determined in the cell-free system, consisting of 1% deoxycholate-treated, 20 000 g-precipitated particulate fraction (IV), amino acid-incorporating supernatant enzyme (V), amino-acid activating enzyme (VI), adenosine triphosphate, Mg^{++}, and amino acid mixture. IV, V, and VI prepared from Bombyx mori, Attacus ricini, and rat liver, can replace the respective fractions of different animals. The maximum incorporation rate of I, II, and III is attained by using the IV preparations from B. mori, A. ricini, and rat liver, respectively, regardless of the source of V and VI. A. ricini is more unstable than IV of B. mori or rat liver, especially the activity towards I. (CA 58: 1963, 8164g)

296 Szafranski, P., Lutowicz, J., Puzynska, L. THE AMINO ACID CODE AND BIOSYNTHESIS OF THE SILK. Life Sci. 11 (1963) 845-51.

Silkglands of the silkworm are useful since in a cell-free system polynucleotides may lead to information on the synthesis of a given polypeptide, and the glands produce fibroin and sericin of a known and very specific amino acid composition. RNA from posterior and middle silkglands (5th instar Bombyx mori) was fractionated and the nucleotide composition established for each fraction. Based on the content of amino acids in the silk protein the nucleotide composition of the so-called "messenger RNA" (mRNA) was calculated and compared with the composition of received fractions. The influence of those fractions upon the incorporation of the C^{14}-labelled amino acids (specific for silk) into the cell-free system from E. coli was then investigated. After P^{32}-incorporation into the glands, middle and posterior RNA was separated out. Results are tabulated and discussed.

297 Tanaka, S. TRANSFER OF RADIOACTIVITY FROM RELABELED CELL DEBRIS TO PARTICULATE FRACTIONS IN THE POSTERIOR SILK GLANDS. Seikagaku Zasshi 33 (1961) 390-9.

Amino acid-incorporating activity of posterior silk glands was studied on the sub-cellular level. Posterior silk glands of Bombyx mori were homogenized and centrifuged to give cell debris (CD), large particles (RL), small particles (E_1), a fraction (E_2) containing amino acid-incorporation enzyme, and a fraction (E_3) containing amino acid-activating enzyme. To prepare C^{4}-labelled CD in vivo, 2 μc of glycine-2-C^{14} was injected into a silkworm, and the above procedure was undertaken. Incubation of sliced glands with glycine-2-C^{14} and the subsequent homogenization was employed to prepare C^{14}-labelled CD in vitro. Transfer of radioactivity from C^{14}-labelled CD to E, reached an equilibrium in 15 min, and required the presence of an amino acid mixture, guanine triphosphate, an energy source such as creatine plus creatine kinase, and E_2 but not E_3. Transfer of the radioactivity to RL was also observed under similar incubating condition, but inhibition was induced by the pre-treatment of C^{14}-labelled CD with either ribonuclease (100 γ/ml), deoxyribonuclease (100 γ/ml), deionized water, or deoxycholic acid (0.5%). Chloramphenicol (10^{-4} M), N mustard (10^{-5} M), and 2,4-dinitrophenol(10^{-4}M) did not inhibit the transfer reaction. (CA 55: 1961, 23843g).

298 Tanaka, S., Suzuka, I., Shimura, K. INTERACTION OF ADENOSINE TRIPHOSPHATE (ATP) WITH GLYCINE-ACTIVATING ENZYME. J. Biochemie, Tokyo 51 (1962) 447-9.

The crude glycine(I)-activating enzyme (II) preparation of the posterior silk gland of Bombyx mori was further purified by precipitating with $(NH_4)_2SO_4$ (100% saturation) and by freeing from ribonucleic acids by diethylaminoethyl cellulose column chromatography. Upon incubation of II with ATP-β,γ-P^{32} at pH 8.0 (37°C, 10 min) the formation of II-ATP-P^{32} (III) is demonstrated as a single fraction in paper electrophoresis at pH 8.0, and also a major component in starch zone electrophoresis at pH 8.0, accompanied by a minor III component. The formation of III requires Mg^{++}. III can be precipitated by saturating with $(NH_4)_2SO_4$ to remove free ATP, and is shown to contain less than 1 mol of ATP/mol of II. In the presence of ribosomal amino acid-incorporating enzyme (IV) and 19 amino acids, purified III more effectively incorporates I-C^{14} into the synthesized protein than a mixture of ATP, I-C^{14}, II, IV, and amino acids. A specific activation of I catalyzed by III, but not by free II, is suggested. (CA 57: 1962, 10218i)

299 Umebachi, Y. YELLOW PIGMENTS IN THE WINGS OF PAPILIONID BUTTERFLIES. VI. RED PIGMENTS OF THE PAPILIONID AND NYMPHALID BUTTERFLIES. Sci. Rep. Kanazawa Univ. 8, 1, (1962) 127-33.

The red brown scales of Papilio protenor on alkaline hydrolysis yielded no xanthurenic acid. Therefore, type B red pigment in the Papilonidae may not be an ommochrome. A similar treatment of type C red pigment of Vanessa indica indicates an ommochrome pigment. Autoradiographs of Graphium sarpedon, whose prepupa had been injected with tryptophan-C^{14}, indicated no incorporation of tryptophan in the type A red wing pigment. Similar treatment of V. indica indicated the incorporation of tryptophan into type C red pigment. (CA 59: 1963, 9120d)

300 Umebachi, Y. YELLOW PIGMENTS IN THE WINGS OF PAPILIONID BUTTERFLIES. VII. CONSIDERATION OF THE NATURE AND DISTRIBUTION OF THE WING PIGMENTS OF THE PAPILIONID BUTTERFLIES. Sci. Rep. Kanazawa Univ. 8, 1 (1962) 135-42.

The yellow pigments of Papilio xuthus, papiliochrome-II and -III, although derived from tryptophan, are not ommochromes since many of their reaction are different. These papiliochromes are probably kynurenine jointed to some substance, perhaps dopa derived o-diphenol. In Papilionidae wings these kynurenine pigments and anthoxanthin are usually mutually exclusive. The yellow kynurenine pigment and type B red pigment may be characteristic of the Papilionidae. Since the pterin pigment is characteristic of the Pieridae and the ommochrome pigment (type C red pigment) is characteristic of the Vanessidi of Nymphalidae, many systematic groups have their own characteristic pigments. These characteristic pigments are synthesized by the animals whereas the anthoxanthin pigment is derived from the plant food of the larva of a widely distributed group of Lepidoptera. Perhaps this last pigment is the pigment of the common ancestor of the Pieridae and Papilionidae. (CA 59: 1963, 9120e)

301 Vanderberg, J.P. THE ROLE OF THE GONADOTROPIC HORMONE IN THE SYNTHESIS OF PROTEIN AND RNA (RIBONUCLEIC ACID) IN Rhodnius prolixus. Biol. Bull. 125, 3 (1963) 576-81.

The hormone from the corpus allatum in R. prolixus is necessary for deposition of yolk in its oöcytes. Incorporation of H^3-labelled precursors of DNA (thymidine-H^3), RNA (uridine-H^3), and protein (leucine-H^3) were studied with bugs decapitated in such a way as to either leave or remove the corpus allatum; the allatectomized bugs showed little difference from the control in DNA synthesis, but RNA and protein synthesis were drastically reduced by removal of the gland. (CA 60: 1964, 9654g)

302 Winteringham, F.P.W., Harrison, A. INCORPORATION OF [2-C^{14}] ACETATE INTO ACETYLCHOLINE OF THE ADULT HOUSEFLY IN VIVO UNDER CONDITIONS OF REST, ACTIVITY AND INSECTICIDAL ACTION. Biochem. J. 78 (1961) 22P.

The [C^{14}] acetylcholine formed in vivo following the intrathoracic injection of [2-C^{14}] acetate into adult Musca domestica was separated by paper chromatography from the other labelled compounds formed and then assayed radiometrically. Maximum specific radioactivity of the acetylcholine fraction was rapidly achieved within 15 min. Anticholinesterases appeared to "uncouple" acetylcholine synthesis in the sense that the overall metabolism of [C^{14}] acetate and respiration were increased while formation of [C^{14}] acetylcholine was considerably reduced. The effect of malathion on [C^{14}] acetylcholine formation was partly reversed on injecting pyridine-2-aldoxime methiodide together with atropine but, unlike the case of diisopropyl phosphorofluoridate, there was no reversal of the outward signs of poisoning. Dieldrin directly affected the metabolism of acetylcholine in vivo.

303 Winteringham, F.P.W., Disney, R.W. RADIOMETRIC ASSAY OF ACETYLCHOLINESTERASE. Nature, Lond. 195 (1962) 1303.

A method is described for the microdetermination of acetylcholinesterase activity in which the formation of acetic acid labelled with C^{14} liberated enzymically from the labelled substrate, is measured by a simple counting technique. The method has the advantage that it can be applied to very small samples of tissue at relatively constant pH. Tests on diluted cholinesterase-active tissue extracts from Musca domestica head are discussed. The technique provides a reliable indicator of reversible cholinesterase inhibition by such compounds as carbamates, for example.

304 Winteringham, F.P.W., Disney, R.W. ACETYLCHOLINESTERASE ACTIVITY AND COMPETITIVE INHIBITION AT LOW SUBSTRATE CONCENTRATIONS. Biochem. J. 88, 3 (1963) 67-68p.

The study of acetylcholinesterase activity over a wide range of substrate concentrations (0.05 - 0.00005 M) is facilitated by radiometric methods. Head tissue of adult Musca domestica and haemolysates of human whole blood were used for enzyme preparation. The effective Michaelis constant, the dissociation constant for the further reaction between normal enzyme-substrate complex and free substrate, and the dissociation constant for the reaction between inhibitor and free enzyme have been evaluated for both preparations in the presence of the insecticide o-isopropoxyphenyl-N-methyl carbamate. The observed and calculated decreases in apparent enzyme inhibition as a result of sample dilution or increasing substrate concentration were in fair agreement. The observations are believed to be of significance in studies of the cholinesterase inhibition and toxicity relationships of the carbamate insecticides and in the measurement of blood cholinesterase inhibition as a result of carbamate exposure in man.

305* Weygand, F. ZUR BIOGENESE DES LEUCOPTERINS. (On the biogenesis of leucopterin). Angew. Chem. 71, 23 (1959) 746. (In German).

On injecting glucose-1-C^{14} into 3-4 d old pupae of the cabbage moth, Pieris brassicae, 53% of the total radioactivity incorporated in leucopterin are found in C-8 and -9. With glucose-2-C^{14} as much as 78% are found there. This and other evidence suggest that the ribose carbon-1 atom is a precursor of C-8 of the pterin.

306* Weygand, F., Simon, H., Schliep, H.J., Dahms, G. ÜBER DIE BIOGENESE DES LEUCOPTERINS. II. MITTEIL. (Further study on the biogenesis of leucopterin). Angew. Chem. 71, 15/16 (1959) 522. (In German).

The distribution of the radioactivity in leucopterin was determined after CH_3CO_2H-1-C^{14}, CH_3CO_2H-2-C^{14}, glycine-2-C^{14} (I), and D-glucose-1-C^{14} (II) were injected into larvae and pupae of Pieris brassicae. I was the main supplier of C atoms 4 and 5, and II of 8 and 9. (CA 54: 1960, 5966e).

307 Weygand, F., Simon, H., Dahms, G., Waldschmidt, M., Schliep, H.J., Wacker, H. BIOSYNTHESIS OF LEUCOPTERIN. Angew. Chem. 73 (1961) 402-7.

To investigate the synthesis and structure of leucopterin (I) C^{14}-labelled purines, pyrimidines, and formic acid and glycine-1-C^{14} are injected into pupae of Pieris brassicae. Formic acid was the precursor of the C-2 atom and glycine contributed C-4 and C-5; C-6 is from CO_2. The exact origin of C-8 and C-9 is doubtful. Sugars and their derivatives are the precursors of C-8 and C-9. The C-9 of I is most probably formed by C-1 of a pentose. It is supposed that I is directly formed from guanine.

See also:

62 Queen bee food juices of the honey bee. V. Formation of the food in the nurse bee. (Rembold and Hanser, 1960)
134 The significance of microorganisms in the nutrition of insects. (Henry, 1962)
151 Biochemistry of diapause, development, and injury in silkworm pupae. (Wyatt, 1963)
163 Transmission of phosphorus-32 incorporated by parents into descendants of Drosophila melanogaster. (Faludi et al., 1961)
170 Pyrophosphate in the hawk moth. (Heller et al., 1960)
197 Polysaccharide and glycoprotein formation in the cockroach. (Lipke et al., 1963)
337 Application of tritiated compounds to the midge Chironomous and some aspects of the metabolism of salivary gland chromosomes. (Pelling, 1962)
343 Structure and function of the giant chromosomes. (Sengün, 1962)
347 Cell sites of RNA and protein syntheses in the salivary gland of Smittia (Chironomidae). (Sirlin, 1960)
351 Macromolecular syntheses in isolated polytene nuclei. (Sirlin and Schor, 1962)
359 Synthesis and transfer of DNA (deoxyribonucleic acid), RNA (ribonucleic acid), and protein during vitellogenesis in Rhodnius prolixus (Hemiptera). (Vanderberg, 1963)
362 Sites of ribonucleic acid and protein synthesis in Drosophila. (Zalokar, 1960)
385 A micromethod for labeling steroids and ecdysone with tritium. (Karlson et al., 1963)
398 Intermediary metabolism in aseptically reared blowfly larvae. II. Biosynthesis of fatty acids and amino acids. (Sedee, 1961)
407 Conversion of pteroyl-L-monoglutamic-2-C^{14} acid into isoxanthopterin Drosophila melanogaster. (Blair, 1961)
420 Cholinesterases in insect muscle innervation, with special reference to the insecticidal effects of DDT and DFP. (Hamori, 1961)
422 Nucleotides and other phosphorus compounds of the cockroach central nervous system. (Heslop and Ray, 1961)
425 The genetics and biochemistry of red fat cells in Drosophila melanogaster. (Grell, 1961)
448 The use of radioactive isotopes for labelling ticks. (Babenko, 1960)
696 Radioisotope studies of pesticide metabolism by the pineapple plant. (Gortner, 1962)

I-B-5 NUCLEIC ACIDS, NUCLEOTIDES

308 Baer, A.S. AUTORADIOGRAPHIC STUDIES OF THE MEALY BUG, Pseudococcus obscurus. Diss. Abstr. 24, 3 (1963) 939.

Males of that species have one haploid heterochromatic and one haploid euchromatic set of chromosomes. The incorporation of tritiated thymidine into DNA by 2nd-instar males was studied. DNA synthesis in the heterochromatic set was found to be asynchronous with respect to that in the euchromatic set. In the euchromatic set DNA synthesis occurs during the first half of the synthetic period whereas DNA replication in the heterochromatic chromosomes occupies the last half of that period. Some data on the mitotic cycle in somatic tissues are presented in terms of the relative lengths of the DNA synthesis period for euchromatin and heterochromatin and in terms of the free pool time of tritiated thymidine. The results are discussed in relation to other previously known features of heterochromatization in this organism. They agree with previous findings on the asynchrony of DNA synthesis in heterochromatin compared with euchromatin and extend the asynchrony up to the level of a full complement of chromosomes.

309 Beermann, W. CYTOLOGICAL ASPECTS OF INFORMATION TRANSFER IN CELLULAR DIFFERENTIATION. Amer. Zool. 3 (1963) 23-32.

The visible differentiation of giant polytene chromosomes in interphase, such as encountered in Chironomus tentans and C. pallidivittatus, is discussed and puffing patterns as patterns of genic activity, in terms of RNA synthesis, are discussed. Results to date are reviewed. Studies in which tritium-labelled nuclei-acid precursors were used showed puffs to be active centres of chromosomal RNA synthesis. The genetic characterization of a specific puffed region in salivary gland chromosomes and the induction and control of puffing are considered.

310 Bensam, A., Kitazume, Y., Yčas, M. RIBONUCLEIC ACID METABOLISM IN THE SILK GLAND. Exp. Cell. Res. 31, 2 (1963) 329-39.

Larvae of Bombyx mori were used at the end of the last instar, between 4 and 2 d before spinning. Some of the initial work was done on larvae of Telea polyphemus. Larvae were injected dorsally with 10-100 µl of neutralized P^{32} orthophosphate or C^{14}-2-glycine. Two methods were used to prepare RNA. To confirm and extend previous results the composition of the RNA from anterior and posterior parts of the silk gland of B. mori was redetermined. Ion exchange chromatography and paper electrophoresis were used. Earlier analytical results on the composition of RNA from Lepidopteran silk glands were confirmed. Pulse labelling failed to detect a rapidly labelled RNA fraction with a composition different from bulk RNA.

311 Bier, K. UNTERSCHIEDLICHE REPRODUKTIONSRATE IM EU- UND HETEROCHROMATIN: EIN WEG ZUR KERNDIFFERENZIERUNG? (Differential reproduction rate in eu- and heterochromatin: a means of nuclear differentiation?) Zool. Anz., Suppl. 25 (1962) 102-10. (In German)

H^{3}-thymidine was used a specific DNA-precursor. A number of Diptera are considered. Nuclear differentiation, as manifested in the size ratio of chromocentre to nucleus in nurse cells of low as well as high polyploidy and in proximal and distal nuclei, is interpreted as the result of differential rates of synthesis in euchromatin and heterochromatin. A lowering in reduplication in heterochromatin is not directly dependent on the kind of tissue or degree of polyploidy but rather the result of its function which here depends on the position of the nucleus relative to the oöcyte.

312 Bier, K. SYNTHESE, INTERZELLULÄRER TRANSPORT, UND ABBAU VON RIBONUKLEINSÄURE IM OVAR DER STUBENFLIEGE Musca domestica. (Synthesis, intercellular transport, and breakdown of ribonucleic acid in the ovary of the housefly, Musca domestica). J. cell. Biol. 16, 2 (1963) 436-40. (In German, with English summary).

Short incubation with tritiated RNA-precursors up to 30 min produces equally high levels of activity in all nurse cells. During this period, tritiated RNA streams from the heavily labelled nurse cell nuclei to the periphery of the trophocytes. Incorporation periods for 45 min or more lead to spots of intense activity in the oöcyte near the intercellular bridges (Fusomes) connecting the proximal nurse cells and the oöplasm. From 1 h after injection onward the activity diminishes in all nurse-cell nuclei and in the cytoplasm of the smaller distal nurse cells. This is considered as evidence of RNA-transport from the nurse chamber into the growing oöcyte. As the insoluble compound of the tracer (i.e., RNA of high molecular weight) does not accumulate in the oöcyte, a high turnover of RNA entering the oöcyte via the intercellular bridges is assumed. It is pointed out that the processes described in this paper are similar to what is to be expected for messenger-RNA. (Auth. summary)

313 Durand, M., Séréno, C. THE SYNTHESIS OF RIBONUCLEIC ACID (RNA) BY THE OVARY OF THE CRICKET. C.R. Acad. Sci., Paris 253 (1961) 556-8.

By means of autoradiography, uptake of tritiated adenosine by the ovary of the cricket (Gryllus bimaculatus) was examined as previously described. Free adenosine and low molecular weight polynucleotides were particularly high after cytoplasmic increase of oocytes and at the beginning of vitellogenesis. In follicular cells, all radioactivity observed in the nucleus was removed by ribonuclease. Not all cells surrounding the oocyte contained radioactivity. In labelled cells, RNA was found in 3 modes: in chromatin only, in nucleolus, and in both chromatin and nucleolus. (CA 56: 1962, 12098d)

314 Favard-Séréno, C.*, Durand, M. L'UTILISATION DE NUCLÉOSIDES DANS L'OVAIRE DU GRILLON ET SES VARIATIONS AU COURS DE L'OVOGENÈSE. I. INCORPORATION DANS L'ARN. Devl Biol. 6, 2 (1963) 184-205.

The uptake of tritiated uridine and cytidine in the RNA of the cricket ovary (Gryllus bimaculatus, Orthoptera) is described in terms of the duration of incorporation and of the physiological condition of the follicles. In the follicle cells, chromosomes are the primary site of RNA synthesis. With increasing incorporation time, labelled RNA moves towards the nucleolus, where it accumulates. Afterward, the radioactivity reaches the cytoplasm. The nucleoli lose their labelled material when the cytoplasmic activity is maximal. The speed of the migration from the nucleus to the cytoplasm depends on the secretory activity of the follicle cells: the more important the activity, the shorter the diffusion time. This fact supports the hypothesis that the labelled RNA of the nucleus released to the cytoplasm is "messenger" RNA. In the oöcyte, the uptake of uridine and cytidine is at first visible in the nuclear sap. Later on, the labelled RNA accumulates in the chromosomes and in the oöplasm. Although high during cytoplasmic growth, the RNA activity drops, in the oöcyte, soon after the beginning of vitellogenesis. (Auth.)

315 Favard-Séréno, C., Durand, M. L'UTILISATION DE NUCLÉOSIDES DANS L'OVAIRE DU GRILLON ET SES VARIATIONS AU COURS DE L'OVOGENÈSE. II. INCORPORATION DANS L'ADN. Devl Biol. 6, 2 (1963) 206-218.

After thymidine injection, the number of labelled follicle nuclei increases when the secretory activity starts and, after 5 minutes of incorporation, approximately one-third of the nuclei are radioactive during the middle stage of vitellogenesis. Later on, there is no further rise in the number of labelled nuclei with increased treatment time. Between the first and the middle stages of vitellogenesis, the radioactivity becomes higher in the nuclei in relation with the increasing amount of DNA per polyploid follicle nucleus. No uptake of thymidine is visible in the germinal vesicle. When the secretory activity of the follicle cells reaches its maximum, radioactive DNA occurs in their cytoplasm and in the oöplasm. During vitellogenesis, and following long treatment time, uridine is incorporated into DNA in the same way as thymidine. At the middle stage of vitellogenesis, cytidine follows a special pattern of incorporation: 24 h after injection, the DNA labelling extends to 100% of the follicle nuclei. The origin of the late DNA precursor is discussed. (From auth.)

316 Ficq, A., Pavan, C. METABOLISM OF NUCLEIC ACIDS AND PROTEINS IN GIANT CHROMOSOMES. Path. Biol. Sem. Hôp. 9 (1961) 756-7.

Autoradiographs are shown for the incorporation of tritium-labelled cytidine, uridine, lysine, and leucine (I) into giant chromosomes of the salivary glands of larvae of Rhynchosciara angelae. I was incorporated into an unstable protein with great metabolic activity, more closely associated with the ribonucleic acid than with the deoxyribonucleic acid of the chromosome bands. (CA 55: 1961, 19049c)

317 Fujita, S., Takamoto, K. SYNTHESIS OF MESSENGER RNA (RIBONUCLEIC ACID) ON THE POLYTENE CHROMOSOMES OF DIPTERAN SALIVARY GLAND. Nature, Lond. 200 (1963) 494-5.

Tritiated uridine (1-5 µc) mixed with 5-10 mM unlabelled thymidine was injected in larva of Brillia spp. (Chironomidae). Salivary glands were fixed ½ to 48 h after injection, paraffin sections prepared, and autoradiographs made. Patterns of Ag grains on and about the chromosomes suggest that specific regions of deoxyribonucleic acid (DNA) in the chromosomes are inactivated by a folding process to mask portions of the DNA to regulate formation of messenger RNA. (CA 60: 1964, 2084f)

318 Гинзбург, Г.И. АВТОРАДИОГРАФИЧЕСКОЕ ИССЛЕДОВАНИЕ ВКЛЮЧЕНИЯ ТИМИДИНА-Н В ПРОЦЕССЕ ОВОГЕНЕЗА. Ж. общ. Биол. 24, 1 (1963) 71-3.

Gintsburg, G.I. AUTORADIOGRAPHIC INVESTIGATION OF THYMIDINE H^{3} INCORPORATION DURING OÖGENESIS. Zh. obshch. Biol. 24, 1 (1963) 71-3.

To solve the problem of ways of "reserve" DNA accumulating in the cytoplasm of the oöcyte, 3-5 c/g H^{3}-labelled thymidine was injected into the abdomen of Coreus marginatus females. Ovaries were fixed after 3-180 min. No considerable incorporation into the nuclei of ovarial cells could be found after 30 min. After 60-180 min heavy labelling occured in the feeding cells and nearly all the follicular cells of the growing oöcytes but only in individual cells of oöcytes which had just started to grow or had terminated growth. No incorporation into embryonic vesicles was found. Along with the incorporation of the label into the follicular cells, it was incorporated into the cytoplasm, and was retained even after treatment with RNAse. Sometimes considerable incorporation into the oöcyte membrane was noticed, as well as a shift into the cytoplasm of follicular cells (toward the oöcyte) of the nuclear substance stained with methyl green. The nuclear stain with methyl green and Feulgen in follicular cells was always more intensive than that in feeding ones. All this suggested that during intensive growth of the oöcyte the cells are in a state of high metabolic activity and seem to be able to participate in the accumulation of nutritive substances and DNA derivatives in the oöcyte. (From English summary)

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* See also Séréno: 313, 345, 346.

319 Henderson, S.A. DIFFERENTIAL RIBONUCLEIC ACID SYNTHESIS OF X (CHROMOSOME) AND AUTOSOMES DURING MEIOSIS. Nature, Lond. 200 (1963) 1235.

Ribonucleic acid (RNA) biosynthesis was followed autoradiographically through all stages of male meiosis in the locust Schistocerca gregaria, using H^3-uridine. All autosomes actively synthesize RNA throughout the whole of first meiotic prophase. Synthesis decreases progressively during diakinesis, as chromosome coiling becomes more and more complete, and has ceased by the time that nuclear membrane breakdown occurs. No RNA precursor is incorporated into any autosome during first metaphase or anaphase. Throughout most of meiosis the single X-chromosome is allocyclic relative to the autosomes. No RNA precursor is incorporated and the X-chromosome is unlabelled throughout its entire length. (CA 60: 1964, 8385g)

320 Hosoda, J., Shigematsu, H., Takeshita, H., Mizumo, S., Takahashi, H., Maruo, B. RIBONUCLEIC ACID METABOLISM IN THE POSTERIOR SILKGLAND OF SILKWORM, Bombyx mori, DURING THE FIFTH INSTAR. Biochim. biophys. Acta Previews 3, 3 (1963).

See 321.

321 Hosoda, J., Shigematsu, H., Takeshita, H., Mizumo, S., Takahashi, H., Maruo, B. RIBONUCLEIC ACID (RNA) METABOLISM IN THE POSTERIOR SILK GLAND OF SILKWORM (Bombyx mori) DURING THE FIFTH INSTAR. Biochim. biophys. Acta 72, 4 (1963) 544-54. (In English).

The base composition of the bulk RNA did not change significantly during the instar. P^{32}-pulse labelling during the earlier stage of the instar indicated the synthesis of a rapidly turning-over RNA having a base composition different from that of ribosomal RNA and resembling that of DNA. Sedimentation analysis of RNA at this stage revealed the presence of components having different sedimentation constants from those of the ribosomal and soluble RNA. At a later stage of the instar, there was no evidence for the occurrence of a rapidly turning-over RNA having a base composition different from that of ribosomal RNA. The role of RNA in silk fibroin synthesis is discussed. (CA 59: 1963, 11944d)

322 Keyl, H.-G., Pelling, C. DIFFERENTIELLE DNA-REPLIKATION IN DEN SPEICHELDRÜSEN-CHROMOSOMEN VON Chironomus thummi. (Differential DNA replication in the salivary-gland chromosomes of Chironomus thummi). Chromosoma 14 (1963) 347-59. (In German).

Bastard larvae from Ch. th. piper ♀ x Ch. th. thummi ♂ in late 4th instar or as prepupae were used. H^3-thymidine (specific activity 3.0 c/mM) and $2.C^{14}$-thymidine (specific activity 26 mc/g), in aqueous isotonic maltose solution were injected into the haemolymph (0.25-1.0 μl). Various time intervals were allowed between injections. The course of DNA synthesis was followed autoradiographically and analyzed. DNA replication starts simultaneously in all transverse bands with a continuous thymidine uptake. In the final phase DNA synthesis can only be detected in the heterochromatic structures. All remaining transverse bands have completed DNA synthesis earlier, following a set sequence of events.

323 Krishnakumaran, A., Schneiderman, H.A. NUCLEIC ACID METABOLISM IN PUPAL TISSUES OF SATURNIID LEPIDOPTERA (Abstr. only). Amer. Zool. 3, 4 (1963) 298.

Ribonucleic acid and desoxyribonucleic acid metabolism of individual tissues in pupae of Hyalophora cecropia and Samia cynthia were studied at various stages using autoradiographic techniques. Cecropia has an obligatory pupal diapause and although DNA synthesis and cell division proceed vigorously in larvae and prepupae, pupation signals cessation of DNA synthesis in most tissues. Thus incorporation of thymidine stops in epidermis, muscles, fat body, tracheae, wing buds, malpighian tubules and gut. However, the brain synthesizes DNA for 5 d after pupation and haemocytes remain acitve throughout diapause. In contrast, some strains of Cynthia have no diapause; in such non-diapausing pupae DNA synthesis continues after pupation. Each tissue has its own programme of DNA synthesis during adult development; the epidermis is the first to synthesize DNA. Muscles and fat body follow. Thus in Cynthia there is no period of dormancy as marked by the inability of tissues to synthesize DNA. Analysis of ribonucleic acid metabolism of Cecropia pupae revealed that different tissues are "turned off" at different stages after pupation and that some remain active. Thus epidermis and the muscles of the anterior region continue RNA synthesis for only 2 d after pupation, while fat body and wing buds continue until about 10 d after pupation. In contrast, malpighian tubules, nervous tissue and haemocytes synthesize RNA at a significant rate throughout the pupal life. As might be expected all tissues of non-diapausing Cynthia synthesize RNA throughout the pupal stage.

324 Leach, W.M. THYMIDINE "POOL" IN GRASSHOPPER NEUROBLASTS. (Abstr.). ASB Bull. 10, 2 (1963) 32.

Embryos of the grasshopper (Chortophaga viridifasciata (De Geer) were incubated in tritiated thymidine (H^3T) and successively rinsed in 3 solutions. Observation of living neuroblasts and reidentification of the same cells in autoradiograms revealed that (1) corresponding portions of sister chromatids were labelled in the 1st division following incubation in H^3T; (2) some sister chromatids were labelled in complementary portions and some were labelled in corresponding portions in the 2nd division following incubation in H^3T; and (3) neuroblasts that were not in deoxyribonucleic acid (DNA) synthesis during incubation in H^3T incorporated H^3T into DNA during the succeeding DNA synthetic period. Results are interpreted as evidence of intracellular persistence of thymidine derivatives between periods of DNA synthesis.

325* Lima-de-Faria, A. INCORPORATION OF TRITIATED THYMIDINE INTO MEIOTIC CHROMOSOMES. Science 130 (1959) 503-4.

Grasshoppers (Melanoplus differentialis differentialis Thomas) were injected with tritiated thymidine (500 μc/ml), each animal receiving 0.02-0.04 ml. After 2-7 d the testes were fixed, squashed and Feulgen-stained. At pachytene, the sex chromosome in the spermatocyte forms a large block of heterochromatin which is quite distinct from the euchromatin of the autosomes. The hetero and euchromatin were found to synthesize DNA at a different time, the heterochromatin synthesizing DNA later.

326* Lima-de-Faria, A. DIFFERENTIAL UPTAKE OF TRITIATED THYMIDINE INTO HETERO- AND EUCHROMATIN IN Melanoplus AND Secale. J. biophys. biochem. Cytol. 6 (1959) 457-66.

Grasshoppers (M. differentialis) were injected with tritium-labelled thymidine. At intervals autoradiographic stripping film was applied over Feulgen squashes and sections. In this species during early prophase of meiosis the sex chromosome forms a heterochromatic block large enough to be resolved in H^3 autoradiographs. A study of the squash preparations reveals that the sex chromosome is synthesizing DNA at a different period of time from the euchromatic autosomes. Since there is a developmental sequence of spermatocyte cysts along the testicular tubes it is possible from the sections to show that the heterochromatin synthesizes DNA later than does the euchromatin. Corresponding studies were carried out on rye (Secale). The asynchrony of synthesis was found to occur within each chromosome in rye. Counts of Ag grains disclosed that the number of grains per unit area was 2-3 times higher over the heterochromatin. To check the DNA content, Feulgen photometric measurements were made of Melanoplus at nuclei at the same stage. The Feulgen and grain counts agree in showing that the heterochromatin contains 2-3 times more DNA per unit area than the euchromatin. (From auth.)

327 Lima-de-Faria, A. INITIATION OF DNA SYNTHESIS AT SPECIFIC SEGMENTS IN THE MEIOTIC CHROMOSOMES OF Melanoplus. Hereditas 47, 3-4 (1961) 674-94.

Autoradiographic stripping film was applied over Feulgen squashes and sections of spermatocytes of the grasshopper M. differentialis after an injection of tritiated thymidine into the body cavity. Testes were fixed 9-12 d following injection. In chromosomes at late pachytene the labelling was found to occur in clusters of Ag grains distributed along the entire length of the chromosome body at ca. 3 μ-intervals. As synthesis progresses the chromosomes get heavily labelled, and finally the number of grains taper off until synthesis ends. Measurements of the amount of DNA along the chromosome were made with a highly sensitive automatic recording microspectrophotometer, with a photocell aperture corresponding to 0.7 x 0.7 μ in the object plane. Absorption was measured along 1.3 μ-segments. The occurrence of grain clusters at 3 μ-intervals was not correlated with a higher DNA content of the chromosome segments involved. The initiation of DNA synthesis does not take place simultaneously along the whole meiotic chromosome, but rather occurs at specific segments. Crossing-over between genes may more easily take place at sites where DNA replication is initiated.

328 Lima-de-Faria, A. METABOLIC DNA (DEOXYRIBONUCLEIC ACID) IN Tipula oleracea. Chromosoma 13 (1962) 47-59. (In English).

In T. oleracea females a Feulgen positive body is present in the oögonia and oöcyte nuclei. By metaphase I the body is not seen. Injection of H^3-thymidine into the larvae leads to a heavy labelling of the Feulgen-positive body. The body is found to synthesize DNA at a different period of time from the chromosomes, and there is an intermediate period when the synthesis of the two nuclear structures overlaps. The H^3-thymidine is released from the body between the 3rd and 4th d of pupal life. At this time the yolk granules in the cytoplasm become particularly conspicuous. When the body disintegrates, the labelled material becomes easily diluted. The volume of the nucleus and of the cytoplasm are sufficiently large to dilute this material in such a way that it becomes indistinguishable from background radiation. Spectrophotometric measurements of the body reveal that it contains 4 times more DNA per unit area than the chromosomes. The amount of DNA in the body is of a higher order of magnitude than that found in all the chromosomes. This large amount of DNA becomes suddenly available either to the chromosomes or other cellular components. DNA can carry its own genetic information to other cellular components. (CA 57: 1962, 11685i)

329 Lima-de-Faria, A., Nordqvist, T. DISINTEGRATION OF H^3-LABELED SPERMATOCYTES IN Melanoplus differentialis. Chromosoma 13 (1962) 60-6. (In English).

Whole cysts in the testicular tubes of M. differentialis disintegrate, giving rise to large Feulgen-positive bodies. The disintegration affects all the nuclei of a cyst. The Feulgen-positive bodies are strongly labelled with H^3-thymidine. Spectrophotometric measurements reveal that the bodies contain 3.5 times more deoxyribonucleic acid (DNA) per unit area than the autosomes of normal spermatocyte nuclei on an equal amount of DNA per unit area as the sex chromosome of the same nuclei. This regular disintegration of spermatocytes is not considered as a pathological condition but as an adaptation by which large amounts of DNA are easily released at a convenient time of development. (CA 57: 1962, 11685f)

330 Matsuzaki, K. THE INCORPORATION OF C^{14}-GLYCINE INTO THE SOLUBLE RIBONUCLEIC ACID (S-RNA) OF THE POSTERIOR SILK GLAND. J. Biochem., Tokyo 53 (1963) 326-7.

Posterior silk gland of Bombyx mori was homogenized, centrifuged (105000 g, 2 h), the supernatant adjusted to pH 5, the precipitates chromatographed on a DEAE-cellulose column, and activating enzyme (I) eluted by 0.1-0.3M KCl. I catalyzed incorporation of glycine-U-C^{14} (II) into aminoacyl-s-RNA in the presence of adenosine triphosphate, Mg and s-RNA. I was highly specific for II incorporation and did not incorporate any significant amount of leucine-1-C^{14} into s-RNA. Under similar conditions II was not appreciably incorporated into high-molecular weight (microsomal ?) RNA. (CA 59: 1963, 15650b)

331 Max-Planck-Institut für Biologie, Tübingen, Germany. ABTEILUNG BEERMANN (Pelling). Naturwissenschaften 49, 18 (1962) 560. (In German)

The incorporation of H^3-uridine as radiactive RNA-units into the Balbiani rings of the salivary gland chromosomes of Chironomus tentans may take place simultaneously with thymidine incorporation in DNA. Autoradiographs, however, indicate a drop in RNA synthesis during DNA replication so that the possibility of an interference of the two processes can not be excluded.

332 McMaster-Kaye, R. THE METABOLIC CHARACTERISTICS OF NUCLEOLAR, CHROMOSOMAL AND CYTOPLASMIC RIBONUCLEIC ACID OF Drosophila SALIVARY GLANDS. J. biophys. biochem. Cytol. 8, 2 (1960) 365-78.

Incorporation and retention of adenine-8-C^{14} and of $P^{32}O_4$ by nucleolar, chromosomal, and cytoplasmic RNA have been studied. Radioisotope concentrations were determined from autoradiographs, by grain counting, and RNA concentrations by microphotometry after basic staining. The relation between rates of RNA accumulation and rates of adenine incorporation was used to determine if synthesis was used to replace RNA which was lost from a fraction, and to obtain estimates of turnover rate. Nucleolar incorporation patterns indicate its incorporation is independent of growth, and there is complete turnover of the fraction in an hour or less. Nucleolar turnover is attributed to degradation of RNA within the nucleolus rather than to movement of intact molecules from the nucleolus. Chromosomal RNA reaches a much lower maximum specific activity than nucleolar, and a slightly higher maximum than cytoplasmic RNA. It showed faster incorporation than cytoplasmic RNA while accumulating RNA at the same rate as the cytoplasm, suggesting chromosomal RNA turnover. No evidence of cytoplasmic RNA turnover was found: rate of incorporation and rate of growth were correlated, and retention studies detected no decrease in amount of RNA-C^{14}, RNA-P^{32}, or RNA. Different ultimate precursors are indicated for nucleolar and non-nucleolar RNA by the observation that the nucleolar precursor is labelled before the precursor of non-nucleolar RNA. (Auth.)

333 McMaster-Kaye, R.D. SYMPOSIUM: SYNTHETIC PROCESSES IN THE CELL NUCLEUS. III. THE METABOLISM OF NUCLEAR RIBONUCLEIC ACID IN SALIVARY GLANDS OF Drosophila repleta. J. Histochem. Cytochem. 10 (1962) 154-61.

In 2nd day larvae salivary gland nucleoli reached maximum incorporation of P^{32} into RNA in 2 h and then lost 20% of activity/h. Chromatin and cytoplasmic RNA reached maximum in 8 h. (CA 56: 1962, 14749g).

334 Mead, C.G. THE RELATIONSHIP OF DNA-ASSOCIATED RNA WITH EUCHROMATIC AND HETEROCHROMATIC DERIVED DNA OF Drosophila melanogaster. (Abstr.). Genetics 47, 8 (1962) 970.

In the process of isolating Drosophila DNA free of cytoplasmic RNA, a small fraction of RNA consistently is found associated with the DNA. The nature of this association between DNA and RNA and its relationship with euchromatic and heterochromatic derived nucleic acids has been investigated. The molar nucleotide ratio of the DNA-associated RNA is identical to that of the corresponding DNA (equating U with T) but different from that of the microsomal RNA. The ratio of the DNA to its associated RNA is found to be 2:1. The RNA is sensitive to both alkaline hydrolysis and ribonuclease digestion. A study of the rate of incorporation of P^{32} orthophosphate into the nucleic acids of 3rd instar larvae demonstrates that the DNA-associated RNA incorporates P at a much higher rate than the microsomal RNA. Ultracentrifugal studies demonstrate a marked increase in the sedimentation velocity of the associated DNA after removal of the RNA with ribonuclease. The melting temperature (T_m) of the associated DNA is increased as a result of ribonuclease digestion. These data are interpreted as evidence of a DNA-RNA complex. The RNA of this complex exhibits many of the properties of "messenger RNA". Samples of these nucleic acid fractions derived from adult males that were coisogenic except for the presence or absence of a Y chromosome have also been examined. The DNA-associated RNA from XO and XY males exhibit molar nucleotide ratios which are identical. The major difference resulting from the addition of the Y chromosome to the genome appears to be that of a 5-10% increase in the amount of DNA as compared to the associated RNA. The simplest interpretation of the data is that heterochromatic DNA such as that derived from the Y chromosome of Drosophila does not contain an associated RNA.

335 Mead, C.G. A DNA-ASSOCIATED RNA FROM Drosophila melanogaster. (Abstr. D1C965). p.105 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC, Nov. 1963.

A DNA-associated RNA has been isolated and purified from adult Drosophila extracts. Several of the properties exhibited by this RNA are consistent with those postulated for an RNA serving as intermediate in the transfer of genetic information. The ratio of DNA:RNA was ~2:1 on a molar nucleotide basis. The molar nucleotide composition of the RNA was similar to that of DNA (equating U with T) and distinct from that of microsomal RNA or soluble RNA. Treatment with RNase, DNase, or by heat denaturation altered the sedimentation properties of the DNA-RNA complex. The T_M of the DNA, however, was only slightly increased (2°C) after removal of the RNA with RNase. The RNA associated with the DNA of 3rd instar larvae was found to be highly metabolically active with respect to P^{32} incorporation. Two types of RNA were distinguished by their relative metabolic stabilities, both of which were associated with the DNA.

336 Noguchi, T., Shigematsu, A., Igarashi, Y. STUDIES ON THE MODE OF ACARICIDAL ACTION, TRACING S-35 AND P-32 ELEMENTS INCORPORATED INTO ORGANISMS in vivo. p. B-9 in "The 4th Japan Conference on Radioisotopes - October 1961". Tokyo, Japan Atomic Industrial Forum, Inc.

Microautoradiography and biochemical analysis were used for studying the effects of diphenyl sulfone, diphenyl carbinol, diphenyl sulfonate and others on metabolism. S^{35}-labelled compounds were synthesized and their metabolism, incorporation and distribution studied by autoradiography. Their effects on phosphorus metabolism was determined biochemically for the silkworm and Acarina in terms of the turnover rate of P^{32}. The results show that the chemicals reduce the turnover rate of the intermediary metabolites of phosphorus, especially RNA and the acid-soluble fractions. They may therefore inhibit the biosynthesis of protein.

337 Pelling, C. APPLICATION OF TRITIATED COMPOUNDS TO THE MIDGE Chironomus AND SOME ASPECTS OF THE METABOLISM OF SALIVARY GLAND CHROMOSOMES. p.327-34 in "Tritium in the Physical and Biological Sciences. Vol.II. Proceedings of a Symposium, Vienna, 3-10 May 1061". Vienna, International Atomic Energy Agency. 1962.

The investigations were carried out on the salivary gland chromosomes of Chironomus tentans. Tritiated compounds (H^3-thymidine, H^3-uridine, H^3-amino-acids), injected into the haemolymph of the larvae should indicate the place of incorporation within the giant chromosomes. After fixation of the salivary glands autoradiographs of the squash-preparations were made. The autoradiographs show that giant chromosomes are most suitable for localizing the activity at chromosomal structures with high resolution. DNA-synthesis (thymidine), RNA-synthesis (uridine) and protein-synthesis within the cell could be followed by determining the time and, approximately, the quantity of incorporation: contrary to the protein-synthesis, the DNA-synthesis and the RNA-synthesis are restricted to the chromosomes. The essential physiological activity of the chromosomes seems to be represented by RNA synthesis which takes place at certain distinct loci (nucleolar organizers, "Balbiani-rings", puffs, and other chromosomal bands). The report discusses some features of RNA synthesis. (From auth.)

338 Plaut, W. ON THE REPLICATIVE ORGANIZATION OF DNA IN THE POLYTENE CHROMOSOME OF Drosophila melanogaster. J. Molecular Biol. 7, 6 (1963) 632-5.

Salivary glands were disserted from larvae of various stages of naturation and incubated, in vitro in a medium also containing tritiated thymidine. The appearance of discrete labelling sites on autoradiographic preparations of pulse-labelled Drosophila salivary gland chromosomes indicates the presence of several independent points of DNA synthesis along the length of these polytene structures. While subject to an alternative interpretation, the data are most simply reconciled with the presence of several molecular ends in the DNA complement along the axis of each chromosome arm. (Auth.)

339 Sengün, A. INCORPORATION OF TRITIATED THYMIDINE INTO THE GIANT CHROMOSOMES OF Chironomus plumosus (Tendipes plumosus) LARVAE. Path. Biol. Sem. Hôp. 9 (1961) 753-5. (In English).

Larvae of Chironomus were placed in solutions containing H^{3}-thymidine or injected with small quantities of the solution. The salivary glands and Malpighian tubules were dissected, fixed in acetic acid-alcohol and autoradiographs prepared with stripping film. Labelling of the nuclei of the cells occurred sporadically in both tissues. In some of the nuclei the chromosomes were labelled approximately in accordance with the amount of DNA in the various parts. However, in many nuclei only parts of the chromosome complement incorporated the label. These parts were either large sectors of a few chromosomes, many different bands or groups of bands; or in some instances very small regions of one or a few bands to which the label was restricted. The observations can be accounted for by asynchronous duplication of the various regions of the chromosomes. However, the lack of any uniform pattern of incorporation among the cells of a gland appears to be incompatible with suggestions of a special functional significance to the synthesis of DNA at loci in giant chromosomes. (Auth. summary).

340 Sengün, A. EXISTENCE OF TWO KINDS OF DEOXYRIBONUCLEIC ACID (DNA) AND CHROMOSOMAL SECRETION AS DEMONSTRATED BY MEANS OF AUTORADIOGRAPHY USING TRITIATED THYMIDINE. Path. Biol. Sem. Hôp. 10 (1962) 1701-5.

By Feulgen staining and autoradiography of the giant chromosomes of Tendipes plumosus, evidence was obtained for 2 kinds of DNA. One kind is associated with the hereditary units (chromonemata) and the other is extrachromosomal. The 2nd type may be found in the nucleoplasm surrounding the chromosomes and in some cases appears to be extruded from the nucleus into cytoplasm. The extrachromosomal DNA does not appear to be associated with any particular structural unit, as seen by electron microscopy of autoradiographs. (CA 58: 1963, 11727g)

341 Sengün, A. THE INCORPORATION OF H^{3}-THYMIDINE INTO THE HOMOLOGOUS GIANT CHROMOSOMES OF Simulium LARVAE. Rev. Fac. Sci. Univ. Istanbul, Ser. B. 27, 2-3 (1962) 129-35.

The larvae were exposed for 3 h and 6 h to H^{3}-thymidine (specific activity 1.9 mc/mM; 60 μc in 10 ml of tap water). The synapsis of the salivary-gland chromosomes of Simulium larvae in incomplete at some points although the disc pattern on each homologous chromosome in regions where they are lying side by side appears the same. In linear as well as lateral patterns of organization the different parts of a chromosome exhibit autonomous behaviour in DNA synthesis. Where a gap in synapsis exists (i.e. where the pairing of the 2 homologous chromosomes is incomplete) each homologous part incorporates H^{3}-thymidine independently so that in some cases the homologous regions of the homologous chromosomes united in one giant chromosome show differences autoradiographically, which may help in investigations into the activity of allele genes combined in one giant chromosome.

342 Sengün, A., Özalpan, A., Anil, D., Üçer, E. THE OCCURRENCE OF METABOLIC DEOXYRIBONUCLEIC ACID IN GIANT CHROMOSOMES. Rev. Fac. Sci. Univ. Istanbul, Ser. B. 27, 2-3 (1962) 151-64.

The salivary-gland chromosomes of dipterous larvae (at any rate, of Drosophila melanogaster and Chironomus plumosus) reach their final stage of development in the prepupal stage. Multiplication of chromonemeta of the giant chromosomes does not occur in pupae. On the contrary, their size is reduced and their disc pattern becomes invisible. An attempt has been made to incorporate H^{3}-thymidine into the salivary-gland chromosomes of pupae, to see whether DNA synthesis occurs in those chromosomes which are already in a state of being digested and no longer multiply. H^{3}-thymidine was injected into pupae 18, 22, 23, 24, 25, 26, and 27 h old. While some regions were highly radioactive other parts of the same chromosome would not incorporate the label. It appears that some regions of the chromosomes are still capable of incorporating H^{3}-thymidine and of synthesizing DNA during their digestion in pupae; DNA synthesis is thus apparently not related to multiplication of chromonemata.

343 Sengün, A. STRUCTURE AND FUNCTION OF THE GIANT CHROMOSOMES. Rev. Fac. Sci. Univ. Istanbul, Ser. B 27, 3-4 (1962).

It was demonstrated by means of radioisotopes that the physiological condition of a giant chromosome along its length is not the same and that the uptake of such substances as H^{3}-thymidine, H^{3}-adenine, P^{32}, S^{35}, etc. varies from region to region of the same chromosome; from chromosome to chromosome in the same nucleus; in a comparison of homologous chromosomes, from nucleus to nucleus in the same tissue; from tissue to tissue in the same larva; and from larva to larva, even when of the same age. Each homologue appears to be acting as a physiological unit in the lateral organization whereas the activity of each daughter chromatid is generally masked for they have the same gene loci. Different degrees of incorporation of labelled substance may sometimes be correlated with morphologically distinct parts of the chromosome such as the heterochromatic and the euchromatic regions. Cytological studies have shown bands to secrete DNA.

344 Sengün, A. STRUCTURE AND FUNCTION OF THE GIANT CHROMOSOMES. (Abstr.). p.278 in "XVI International Congress of Zoology, Washington, 20-27 August 1963. Vol. II". Moore, J.A., Ed. Washington D.C., XVI International Congress of Zoology.

See 343.

345* Séréno, C., Durand, M. INCORPORATION OF TRITIATED ADENOSINE IN THE OVARY OF THE CRICKET (Gryllus bimaculatus). C.R. Acad. Sci., Paris 251 (1960) 2242-4.

Radiographic study of nucleic acids isolated from the ovary after injection of tritiated adenosine in the female cricket shows that the precursors of ribonucleic acid (I) accumulate in the ovary prior to synthesis, that cytoplasmic I is rapidly synthesized during active protein synthesis, and that there is an accumulation of I in the cytoplasm of the oöcyte when deoxyribonucleic acid levels are elevated. (CA 55: 1961, 14734d)

346 Séréno, C., Durand, M. INCORPORATION OF TRITIATED URIDINE INTO CRICKET OVARIES. C.R. Acad. Sci., Paris 253 (1961) 734-9.

Uridine-H^{3} was injected into the abdominal cavities of adult female crickets (Gryllus bimaculatus). The gonads were removed after 24 h and examined histologically and autoradiographically. In follicular cells uridine was incorporated more rapidly into ribonucleic acid (I) than into deoxyribonucleic acid. In ovocytes labelling was almost entirely restricted to RNA. (CA 56: 1962, 5233b)

347* Sirlin, J.L. CELL SITES OF RNA AND PROTEIN SYNTHESES IN THE SALIVARY GLAND OF Smittia (CHIRONOMIDAE). Exp. Cell Res. 19 (1960) 177-80.

Early prepupae of Smittia sp. were injected ventrally in the 2nd (wing) segment, where the greater part of the salivary glands is contained, with ~0.015 μc (0.015 mm^{3}) tritiated uridine, leucine or thymidine. (Uridine, nominally 5,6-H^{3}; DL-leucine-H^{3}, general label; thymidine, probably 6-H^{3}; with specific activities of 63, 102.2 and 360 mc/mM, respectively). Their uptake by salivary gland cell components is described and some of the implications mentioned. Intense local protein synthesis in cytoplasm has been observed.

348* Sirlin, J.L., Jacob, J. CELL FUNCTION IN THE OVARY OF Drosophila. II. BEHAVIOR OF RIBONUCLEIC ACID (RNA). Exp. Cell Res. 20 (1960) 283-93.

Female D. melanogaster were fed for 3 h on food containing orotic acid-6-C^{14}, for 0-6 h on food with non-radioactive orotic acid. Autoradiographic scoring of the tracer in ovarian nurse cells, oöcytes, and follicle cells showed that ribonucleic acid (RNA) function is intense at the point of contact of RNA masses with chromatin. (CA 55: 1961, 23847c)

349 Sirlin, J.L., Kato, K.-I., Jones, K.W. SYNTHESIS OF RIBONUCLEIC ACID (RNA) IN THE NUCLEOLUS. *Biochim. biophys. Acta* *48* (1961) 421-3.

An important amount of nuclear RNA is turned over in the nucleolus, the greatest nucleolar turnover being at the core contiguous with the chromosomal nucleolus organizer. The nature of this RNA was studied by measuring the uptake of H^3-labelled nucleosides by nucleoli, chromosomes, Balbiani ring, and cytoplasm of salivary glands of the chironomid *Smittia* at different stages of larval growth. The pattern of pseudouridine uptake differed from that of the other ribonucleosides. The data indicated the synthesis *in situ* of nucleolar RNA, and suggested that at least part was transfer RNA up to stage III of development. (CA 55: 1961, 25070i)

350 Sirlin, J.L., Jacob, J., Kato, K.-I. THE RELATION OF MESSENGER TO NUCLEOLAR RNA. *Exp. Cell Res.* *27* (1962) 355-9.

Nuclei *in situ* in salivary glands of fully grown larvae (stage IV) of *Smittia* sp. (*Chironomidae*) were pretreated with inhibitors [actinomycin C (Bayer), TRB (4, 5, 6 (5, 6, 7)-trichloro-1-β-D-ribofuranosyl)-benzimidazole; *ex* K. Folkers), and thioacetamide), followed by exposure to H^3-uridine (30 μc/cc). The three classes of inhibited nuclei produced by actinomycin C and TRB, and the two classes produced by thioacetamide are described. Nucleolar RNA has a vectorial turnover with the dense-particulate part at the origin determining either a centrifugal or centripetal stable pattern. The centrifugal turnover pattern used in this work lends itself to inhibition studies. The studies indicate an extrinsic and an intrinsic nucleolar RNA, the former being chromosomal messenger RNA. Messenger RNA, and not organizer DNA, primes intrinsic nucleolar RNA. Free messenger was directly observed in the nucleus and followed to cytoplasm.

351 Sirlin, J.L., Schor, N.A. MACROMOLECULAR SYNTHESES IN ISOLATED POLYTENE NUCLEI. *Exp. Cell Res.* *27*, 1 (1962) 165-7.

Basal salivary-gland nuclei of the sciarid, *Rhynchosciara angelae*, were isolated (by hand) and cultured in a standard medium (Proc. Natl Acad. Sci. 46: 1960, 432), at room temperature, with or without polyvinylpyrollidone, at an empirical 2.8% concentration (PVP-medium). Isolated nuclei were cultured with tritiated guanosine, cytidine or leucine added at 40-150 μc/cc, for 30-90 min. In some experiments the nuclei were precultured in the presence of inhibitors added to the media and then micropipetted into the radioactive medium, or these compounds were offered together with tracer. The processing for autoradiography is described. Non-isolated nuclei in the cultured twin gland were the controls. Incorporation by the glands appears the same *in vitro* as *in vivo.* Isolated nuclei and controls have a similar pattern of nucleoside incorporation but differ for amino acid (leucine). Uptake of nucleosides in isolated nuclei is greater in micronucleoli and unorganized nucleolar masses than in chromosomes (puffs excepted). Incorporation of guanosine is reduced by pre-treatment with 4, 5, 6-trichlororibofuranosylbenzimidazole (0.05 mg/cc) or co-treatment with actinomycin (0.035 mg/cc). Uptake of leucine in non-isolated nuclei, presumably in protein, is slightly greater in nucleolar material than in chromosomes, the reverse applying for isolated nuclei. Co-treatment with puromycin (0.33 mg/cc) seemingly inhibits incorporation.

352 Sirlin, J.L., Schor, N.A. FURTHER OBSERVATIONS ON ISOLATED POLYTENE NUCLEI. *Exp. Cell Res.* *27*, 2 (1962) 363-6.

Chase experiments were performed on nuclei of *Rhynchosciara angelae* pre-incubated with tritiated guanosine (0.2 mM) in 2.8% polyvinylpyrrollidone (PVP) medium for 30 min. The nuclei were then incubated for 3 h in 3 alternative media with 10-fold excess adenosine and guanosine added: (1) standard medium, (2) PVP-medium, and (3) PVP-medium with 0.2 mM 2-3-dinitrophenol (DNP). In (2) a loss of $\frac{1}{2}$ - $\frac{1}{3}$ of their RNA label in chromosomes and nucleolar material was observed, compared with controls. DNP slightly inhibited loss. Pretreatment of nuclei with dilute acetate buffer (pH 4.5) in (1) lowered the subsequent uptake of cytidine or guanosine offered in (2), and chromosomes were damaged. When both buffer and tracer were each offered in (2) the incorporation of leucine mainly into protein was not inhibited. Pretreatment with DNP or ethydium bromide (20 μc/cc) had no effect on cytidine uptake when PVP was present throughout incubation. Co-treatment with 5-fluorouridine (1.5 mM) inhibited uridine uptake, preventing the formation of nucleolar material in the chromosomes. This suggests adulteration of RNA through competitive uptake between analogue and nucleoside, which is supported by the actual incorporation of 5-fluorouracil-2-C^{14}. PVP was found to protect against uptake inhibition and to promote release of nuclear RNA when present throughout all incubation steps. Pseudouridine C (7.5-fold excess; *ex* W.E. Cohn) when offered simultaneously with tritiated uridine had no effect on uptake. The absence of organizer results in a peripherally disposed denser-particulate nucleolar region which determines a directional (centripetal) pattern of nucleolar RNA turnover with its origin in that region.

353 Sirlin, J.L. THE NUCLEOLUS. p.25-66 in "Progress in Biophysics and Biophysical Chemistry. Vol.XII". Butler, J.A.V., Huxley, H.E., Zirkle, R.E., Eds. Oxford, Pergamon Press. 1962.

Comprehensive review article, divided into parts on the biology of the nucleolus (physical aspects, studied microscopically and submicroscopically: nucleolus, nucleolus organizer, nucleolus-associated chromatin; physico-chemical and chemical aspects: RNA, DNA, proteins, enzymes, lipids, carbohydrates, minerals; physiology: status of cell, nutrition, turnover; pathological and experimental alterations; behaviour during mitosis; and mode of formation) and its function in terms of enzymes, RNA, transfer RNA, template RNA, the nucleolar organizer, proteins, ribosomal proteins and spindle proteins. - Tracer studies (p.39-42, also figs. 1, 2) have proved particularly useful in RNA turnover studies (nuclear and nucleolar RNA, and interphase nucleolar RNA). - References: p.59-66, the present bibliography being only concerned with a few of these.

354 Sirlin, J.L. ADDENDUM TO "THE NUCLEOLUS". p.319-26 in "Progress in Biophysics and Biophysical Chemistry. Vol.XII". Butler, J.A.V., Huxley, H.E., Zirkle, R.E., Eds. Oxford, Pergamon Press. 1962.

Further sections deal with morphology, tumours, nucleolus-associated chromatin, and biochemical and mechanical aspects of the nucleolus. An extensive bibliography is given.

355 Sirlin, J.L., Tandler, C.J., Jacob, J. THE RELATIONSHIP BETWEEN THE NUCLEOLUS ORGANIZER AND NUCLEOLAR RNA. *Exp. Cell Res.* *31* (1963) 611-5.

Salivary glands from larvae of *Smittia parthenogenetica* in stage III were incubated *in vitro* under a variety of conditions: with tritiated thymidine; with tritiated thymidine and actinomycin D; in the presence of proflavine in the dark, with tritiated uridine added at one stage. The incorporation of thymidine into DNA in the chromosomes (including the organizer) was very strong, while no incorporation was shown by nucleoli except rarely. Proflavine totally inhibited nucleolar RNA synthesis and only partially inhibited chromosomal RNA. The organizer incorporated uridine to about the same concentration as the other chromosome regions. Actinomycin inhibited the incorporation of uridine into nuclear RNAs as described for proflavine. These inhibitions were also observed with tritiated guanosine. The synthesis of nucleolar RNA (*Smittia*) appears to begin in the nucleolus proper and is dissociable from the synthesis in the organizer, a conclusion which may be generally valid. Whatever relationship exists between nucleolar RNA and organizer DNA it is not different from that which exists between nucleolar RNA and other (not necessarily all) chromosomal DNA.

356 Sirlin, J.L., Jacob, J., Tandler, C.J. TRANSFER OF [^{14}C-METHYL] METHIONINE TO NUCLEOLAR RIBONUCLEIC ACID. *Biochem. J.* *87* (1963) 37P.

Salivary glands of the chironomid *Smittia* were cultured *in vitro* in a synthetic medium containing S^{35}- or generally H^3-labelled methionine. Results showed that, in contrast to the incorporation of C^{14}, the incorporation of these tracers into the nucleolus was inhibited by puromycin. Ethionine competitively inhibited the nucleolar uptake of [C^{14}-*methyl*] methionine in the presence of puromycin, which confirms that methionine is a methyl donor. The methylated bases are characteristic of transfer RNA, as previously suggested from the incorporation of pseudouridine (see 349).

357 Steffensen, D.M. EVIDENCE FOR THE APPARENT ABSENCE OF DNA IN THE INTERBANDS OF *Drosophila* SALIVARY CHROMOSOMES. *Genetics* *48*, 10 (1963) 1289-1301.

Drosophila salivary chromosomes were labelled with thymidine-H^3. Distribution of radioactive DNA (deoxyribonucleic acid) was studied by quantitative autoradiography. Stretched chromosomes were examined for the distribution of radioactivity from tritium β-particles over bands and interbands (in overlying Ag halide emulsion). More radioactivity was found in the bands than in the interbands. The level of radioactivity in the interbands did not exceed background count in the nucleoplasm. The majority of evidence indicated that DNA was not present in the interbands. (CA 60: 1964, 8391e)

358 Tandler, C.J., Sirlin, J.L. NUCLEAR POOL OF RIBONUCLEIC ACID (RNA) PHOSPHORUS. *Biochim. biophys. Acta* *55* (1962) 228-30. (In English).

The pattern of incorporation of $P^{32}O_4^{---}$, cytidine-H^3, and guanosine-H^3 was examined in cells of onion and broad-bean rootlets and salivary glands of the chironomid *Smittia*. The former 2 types of cells showed heavy labelling of nucleolus RNA when nucleoside-H^3 was added, while nucleolus RNA was relatively inert with respect to P^{32}. Frequently a ring of chromatin surrounding the nucleolus showed marked incorporation of P^{32}. A sluggish nucleolar P^{32} turnover was also observed in Smittia. (CA 56: 1962, 13223h)

359 Vanderberg, J.P. SYNTHESIS AND TRANSFER OF DNA (DEOXYRIBONUCLEIC ACID), RNA (RIBONUCLEIC ACID), AND PROTEIN DURING VITELLOGENESIS IN Rhodnius prolixus (HEMIPTERA). Biol. Bull 125, 3 (1963) 556-75.

Histochemical and autoradiographic techniques demonstrated that DNA was synthesized in the nuclei of the ovary, fat body, and midgut. There appeared to be a transfer of some of the DNA in a partially depolymerized form from the ovarian trophic tissues to the growing oöcyte. RNA was synthesized in the nuclei of the ovary, fat body, and midgut, and then was transferred to the cytoplasm. Some of the RNA passed from the ovarian trophic tissues to the growing oöcyte. Protein was synthesized most actively in the ovarian follicular epithelium, and in the fat body. Newly synthesized protein was transferred from the follicular epithelium to the oöcyte. Synthesis of yolk protein by the oöcyte itself appeared to be negligible. (Auth.)

360 Watkins, M.J. INTERFEROMETRIC AND AUTORADIOGRAPHIC STUDIES OF GRASSHOPPER CHROMOSOMES. Summer Meeting of American Society of Zoologists, Oregon State University, Corvallis, Oregon, August 1962. Amer. Zool. 2, 3 (1962) 457.

361 Woods, P.S., Gay, H., Sengün, A. ORGANIZATION OF THE SALIVARY-GLAND CHROMOSOME AS REVEALED BY THE PATTERN OF INCORPORATION OF H^3-THYMIDINE. Proc. nat. Acad. Sci., Wash. 47, 9 (1961) 1486-93.

H^3-thymidine was incorporated in young larvae of Drosophila melanogaster by placing them for varying periods in a medium consisting of 0.63 g of standard cornmeal-molasses-agar mixture, 0.08 g of yeast and 28.4 μg of H^3-thymidine, with a specific activity of 244 mc/mM in one series of experiments and 1600 mc/mM in another. Autoradiography was used, also phase contrast microscopy for fine structure, particularly of the interband regions. Findings on the lateral and linear patterns of organization in fully developed chromosomes of the salivary gland are consistent with the view that (1) DNA occurs as a unit which traverses the bands and extends along the full length of the chromosome; (2) the unit occupies only a small part of the cross-sectional area of the chromosome and therefore constitutes a single strand among many; (3) this entity remains intact during succeeding replication (except for possible interstrand exchanges); and (4) DNA may not be distributed uniformly along the strands, because radioactivity appears to be concentrated primarily in regions that correspond to the bands.

362* Zalokar, M. SITES OF RIBONUCLEIC ACID AND PROTEIN SYNTHESIS IN Drosophila. Exp. Cell Res. 19 (1960) 184-6.

Precursors for proteins (DL-leucine-4, 5-H^3, 3570 mc/mM) and for ribonucleic acid (uridine-5, 6-H^3, 640 mc/mM) were injected into adult, egg-laying Drosophila melanogaster. Similar experiments were made with larvae of the 3rd instar at the age of 1 d before metamorphosis. The technique is described. The occurrence of heavy incorporation of H^3-labelled leucine in the cytoplasm before noticeable incorporation in the nuclei indicated that cytoplasm is the main site of protein formation. The experiments give further support to the hypothesis of the nuclear origin of RNA.

363 Zalokar, M. RIBONUCLEIC ACID AND THE CONTROL OF CELLULAR PROCESSES. p.87-140 in "Control Mechanisms in Cellular Processes", Bonner, D.M., Ed. New York, The Ronald Press Company, 1961.

Comprehensive review article, including autoradiographic data obtained for Drosophila (p.91-4, 97, 107, 229), Blattella germanica (p.94-5), Chironomidae (p.94), Bombyx mori (p.125), and Malacosomma americana (p.107-8).

364 Zalokar, M. THE ROLE OF NUCLEOLUS IN THE PRODUCTION OF RIBONUCLEIC ACID. (Abstr.). Genetics 47, 8 (1962) 996.

The incorporation of H^3-uridine into RNA of oöcyte nuclei of Blattella germanica was studied by autoradiography. When oöcytes were incubated in H^3-uridine for four to 16 min, the newly formed, labelled RNA appeared in both nucleoli and chromosomes. Nucleolar RNA was first observed in several spots at the periphery of the nucleolus. After one hour or longer incubation the nucleolus became uniformly labelled. These observations indicate that nucleolar RNA was produced at the periphery of the nucleolus, where the presence of DNA could be demonstrated. It is probably not the nucleolus itself which produces nucleolar RNA, but this DNA belonging to the chromosomal regions adjacent to the nucleolus. Experiments with Actinomycin D showed that this DNA is functionally different from DNA in the rest of chromosomes. When oöcytes were incubated in H^3-uridine in the presence of 2 μg/ml of Actinomycin D, nucleoli remained unlabelled, while chromosomes became labelled nearly as strongly as in the absence of the drug. At higher concentrations (10 μg/ml) Actinomycin D inhibited both nucleolar and chromosomal RNA production. In conclusion it appears that the nucleoli serve as intermediate storage or processing place for a certain kind of RNA, produced by particular regions of chromosomes. The problem of transfer of chromosomal and nucleolar RNA into the cytoplasm is now being studied by inhibiting new RNA formation with Actinomycin D.

See also:

151 Biochemistry of diapause, development, and injury in silkworm pupae. (Wyatt, 1963)
163 Transmission of phosphorus-32 incorporated by parents into descendants of Drosophila melanogaster. (Faludi et al., 1961)
185 Incorporation of P^{32} into the phosphorous compounds of the wax moth larvae. (Wlodawer, 1961)
211 Study on the biosynthesis of pterins in Drosophila melanogaster. (Brenner-Holzach and Leuthardt, 1959)
222 Synthesis and breakdown of proteins and ribonucleic acid in Tribolium confusum. (Devi et al., 1963)
293 Electron microscopic and some biochemical studies on the cell fractions of silkglands. (Suto and Shimura, 1961)
301 The role of the gonadotropic hormone in the synthesis of protein and RNA (ribonucleic acid) in Rhodnius prolixus. (Vanderberg, 1963)
418 Timing of spermatogenesis in Drosophila melanogaster using tritiated thymidine. (Chandley and Bateman, 1962)
419 An autoradiographic study of wound healing in diapausing silkworm pupae. (Davis and Schneiderman, 1960)
421 Nucleotides and other phosphorus compounds of cockroach nerve. (Heslop and Ray, 1961)
422 Nucleotides and other phosphorus compounds of the cockroach central nervous system. (Heslop and Ray, 1961)
426 Cell function in the ovary of Drosophila. I. Deoxyribonucleic acid (DNA) classes in nurse cell nuclei as determined by autoradiography. (Jacob and Sirlin, 1959)
442 Low incidence of polyspermy in Drosophila melanogaster and Drosophila virilis. (Hildreth and Lucchesi, 1962)
443 Fertilization in Drosophila. I. Evidence for the regular occurrence of monospermy. (Hildreth and Lucchesi, 1963)
475 The genetic effects of labelled DNA precursors. (Kaplan et al., 1963)
477 Mutagenic effect of C^{14} and H^3 labelled DNA precursors injected into Drosophila melanogaster males. (Strømnaes, 1962)
985 Chromosome splitting as revealed by combined X-ray and labelling experiments. (Wolff, 1963)
1191 X-ray induced incorporation of tritiated thymidine into grasshopper neuroblast chromosomes. (McGrath, 1963)
1192 X-ray-induced incorporation of tritiated thymidine into deoxyribonucleic acid of grasshopper neuroblast chromosomes. (McGrath, 1963)
1544 Progress in tritium autoradiography. (Lima-de-Faria, 1962)

I-B-6 LIPIDS, STEROL AND STEROID METABOLISM

365* Agarwal, H.C., Casida, J.E. NATURE OF HOUSEFLY STEROLS. Biochem. biophys. Res. Commun. 3 (1960) 508-12.

Sterols were extracted from Musca domestica and purified by digitonin precipitation and chromatography in a silicic acid-celite column with a gradient of Skellysolve C and benzene for elution. Three sterols were recovered from adults and eggs and 4 from larvae and pupal exuviae. The major sterol appeared to be the same in each case. The major sterol, designated muscasterol (I), differs from cholesterol only in the side chain where the isopropyl structure is missing. The side chain of I (starting at C-24) appears to be either $-CH(C_2H_5)_2$ of the α or β form of $-CH(CH_3)C_2H_5$. There was little or no conversion of cholesterol to I when eggs were incubated in a medium containing C^{14}-labelled cholesterol acetate. (CA 55: 1961, 16838f).

366 Agarwal, H.C., Casida, J.E., Beck, S.D. AN UNUSUAL STEROL FROM HOUSEFLIES. J. Insect Physiol. 7 (1961) 32-45.

Sterols (I) were extracted from whole adult Musca domestica and their pupal exuviae. The I were separated into fractions by chromatography, and individual I were identified by chemical and physical means including optical rotations, x-ray diffraction patterns, and infra-red and nuclear magnetic resonance spectra. The major sterol, muscasterol (II), was present throughout the life cycle. Extensive data are given on II whose structure is only partly elucidated. II has many similarities to cholesterol but probably differs in the position of substituents in the saturated side-chain. In metabolic tests, no cholesterol-4-C^{14} appeared to be incorporated into II. The precursor of II may have been a phytosterol supplied in the food. A compound similar to methostenol was found in the larvae and papal exuviae, but it was not detected in the eggs or the adults. 2 minor sterols (A and B) were eluted from silicic acid-celite columns in the positions of Δ^7 -cholestenol and 7-dehydrocholesterol, respectively. Sterol A appeared to be mainly a Δ^7-sterol and sterol B, a $\Delta^{5,7}$-sterol. (CA 57: 1963, 5132f).

367 Agarwal, H.C. STUDIES ON HOUSE FLY STEROLS AND CHOLESTEROL-C^{14} METABOLISM IN HOUSE FLIES AND COCKROACHES. Thesis. Wisconsin. Univ., Madison. 1961.

The nature of the sterols present in the various developmental stages of Musca domestica was investigated. The in vivo esterification of cholesterol-4-C^{14} and hydrolysis of cholesteryl-4-C^{14} acetate in M. domestica L. and Periplaneta americana (L.) were studied. Hydrolysis was more rapid than esterification, and the roach more active than the fly in this respect. In both cases a "cholesterol-like" sterol, more polar steroids and a steryl ester less polar than cholesteryl acetate were recovered. The in vivo balance of sterol and its esters was found to be disturbed by thiocholesterol and DDT (2,2-bis-(p-chlorophenyl)-1, 1,1-trichloroethane). Metabolism of cholesteryl-4-C^{14} acetate was studied in a complete life cycle of the housefly. A preponderance of polar C^{14}-labelled steroids was formed in the eggs, larvae, pupal exuviae and adults. Nymphs of P. americana were similarly studied. The major sterol was again not cholesterol but was slightly less polar. In contrast to the fly, however, the nymph major sterol appeared to be formed from cholesterol. Other sterols behaved similar to Δ^7-cholesterol and possibly 7-dehydrocholesterol in chromatography and the Liebermann-Burchard reaction. A last chromatographic fraction representing both natural and C^{14} materials consisted of more polar steroids. It appears that roaches convert cholesterol into their major sterols, more polar steroids, and a "coprosterol-like" sterol which is excreted in the faeces.

368 Bade, M.L., Clayton, R.B. CHOLESTEROL ESTERS OF THE COCKROACH Eurycotis floridana. Nature, Lond. 197 (1963) 77-9.

Cockroaches were fed a series of diets containing 4-C^{14}-cholesterol. A general procedure for the isolation of cockroach sterol esters is described and the results are tabulated. The major sterol ester of E. floridana reared on diet 1 is cholesterol oleate. (Diet 1 consisted of the semi-synthetic diet of Noland and Baumann, cf. Proc. Soc. exp. Biol., N.Y. 70: 1949, 198, in which the corn oil had been replaced by commercial sodium oleate; it also contained, in addition, 0.1% 4-C^{14}-cholesterol). The remaining sterol esters appear to consist principally of linoleate and a small saturated ester fraction in which palmitate is the principal component.

369 Bridges, R.G., Crone, H.D., Beard, J.R. A STUDY OF THE PHOSPHOLIPIDS OF DIELDRIN-RESISTANT AND SUSCEPTIBLE HOUSEFLIES, WITH PARTICULAR REFERENCE TO THOSE OF THE THORACIC GANGLION. p.145-52 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

A study of housefly phospholipids was made because of the possibility that some alteration in membrane structure or active transport is implicated in the mechanism of dieldrin-resistance in insects. The phospholipids of a dieldrin-resistant strain of housefly and of a susceptible strain from which it was derived were labelled by feeding the flies on P^{32}-labelled orthophosphate solution for 24 h and then allowing them to metabolize the adsorbed P^{32}-phosphate for periods up to 336 h. Thoracic ganglia were removed and the phospholipids separated by chromatography on silicic acid impregnated paper strips. Four major phospholipid fractions can be separated which appear to be the same as those obtained from extracts of whole flies. In the case of whole fly extracts the identity of the fractions is as follows: fraction II phosphatidyl inositol, fraction III lysocephalin, fraction IV a mixture of phosphatidyl choline and an unidentified phospholipid, and fraction V phosphatidyl ethanolamine and phosphatidyl serine. Fraction I consists of non-phospholipid phosphorus-containing compounds. Maximum labelling of the fractions was obtained after feeding the flies (on glucose and water) for one week after removal from the P^{32}-phosphate. The distribution of the P^{32}-activity in the separated fractions from the ganglia of the resistant and susceptible fly showed no significant differences at the time of maximum labelling. There was, however, some evidence for a slower turnover of P^{32}-activity into the two major phospholipid fractions (IV and V) from the resistant fly. This was made more obvious when the flies were fed on milk in addition to glucose and water. Preliminary studies on turnover for much shorter periods were carried out on phospholipid extracts from whole flies injected with P^{32}-labelled orthophosphate solution. These showed a more rapid turnover of P^{32}-activity into the phosphatidyl inositol fraction (II) in the case of the resistant flies, although in these short-term experiments there seems to be no difference in turnover into fractions IV and V from the two strains. The possible significance of the findings is discussed. (Auth.)

370 Chojnacki, T., Piechowska, M.J. BIOSYNTHESIS OF PHOSPHOLIPIDS IN INSECTS. I. INCORPORATION OF P^{32}-PHOSPHOCHOLINE INTO PHOSPHOLIPIDS OF Celerio euphorbiae. Acta biochim. polon. 8, 2 (1961) 157-65. (In Polish, with English and Russian summaries).

A molecule of phosphocholine takes part in biosynthesis of lecithin in Celerio euphorbiae. The rate of incorporation of P^{32}-phosphocholine when followed in homogenates of fat-body is not equal in various stages of the insect growth. It is the highest in caterpillars, while it is a slight one only in spindle, pupa and moth. The incorporation of injected labelled phosphocholine into phospholipids, when observed in vivo, is also in moth 1/3 of that in feeding caterpillars. (Auth.)

371 Chojnacki, T. BIOSYNTHESIS OF PHOSPHOLIPIDS IN INSECTS. II. STUDIES ON INCORPORATION OF P^{32}-ORTHOPHOSPHATE IN Celerio euphorbiae moth. Acta biochim. polon. 8, 2 (1961) 167-75. (In Polish, with English and Russian summaries).

The course of incorporation of P^{32} into phospholipids of the Celerio euphorbiae male moth was investigated. Maximal specific activity of phospholipid fraction was found about 12 h after injection of labelled orthophosphate. Cephalins showed higher rate of regeneration than lecithins did. Cephalins reached their maximal specific activity within 12 h after isotope had been administered while lecithins after 36 h only. The course of incorporation of P^{32} into phosphocholine indicated that phosphocholine might be a precursor of lecithin. The biosynthesis of lecithin in Celerio euphorbiae male moth has been discussed in relation to the storage of pyrophosphate in his ductus ejaculatorius and it has been concluded that the process of local accumulation of pyrophosphate did not run in parallel with the rate of biosynthesis of lecithin in whole body. (Auth.)

372 Chojnacki, T., Korzybski, T. BIOSYNTHESIS OF PHOSPHOLIPIDS IN INSECTS. III. THE INCORPORATION OF (P^{32}) ORTHOPHOSPHATE INTO PHOSPHOLIPIDS OF Arctia caia MOTHS. Acta biochim. polon. 9, 2 (1962) 95-110. (In Polish, with English summary).

The incorporation rate of P^{32} into inositol phosphatide was higher than that into lecithin, phosphatidyl ethanolamine or phosphatidyl serine. The kinetics of labelling do not substantiate the supposition of lecithin or phosphatidyl serine arising from phosphatidyl ethanolamine. Phosphoryl-choline may be the precursor of lecithins. No difference was found in the incorporation rates of P^{32} into lecithins differing in unsaturation degree of fatty acid moieties. (Auth.)

373* Clayton, R.B. THE ROLE OF INTESTINAL SYMBIONTS IN THE STEROL METABOLISM OF Blattella germanica. J. biol. Chem. 235 (1960) 3421-5.

A group of 200 adults roaches were fed 10 g of artificial diet containing 0.1% cholesterol to which 30 mg of sodium acetate-1-C^{14} (1.3×10^7 cpm/mg) had been added. After 25 d, the diet was consumed and the insects killed. The subsequent procedure is described. The principal sterol synthesized under nonaseptic conditions could be shown to be 22-dehydrocholesterol. Evidence is presented for the derivation of this material from ergosterol synthesized by the intestinal flora of the insect. The metabolic conversion of ergosterol to 22-dehydrocholesterol is shown to be independent of the microbial population of the intestine. The possible significance of trace amounts of sterols synthesized in aseptic as well as nonaseptic roaches is discussed.

374 Clayton, R.B., Edwards, A.M. ESSENTIAL CHOLESTEROL REQUIREMENT OF THE ROACH. Biochem. biophys. Res. Commun. 6 (1961) 281-4.

All the tissues of Eurycotio floridana reared on a synthetic diet containing 0.1% cholesterol-4-C^{14} (diet A) contained cholesterol. E. floridana reared on a synthetic diet containing 0.1% cholestanol-7α-H^3 and 0.005% cholesterol-4-C^{14} (diet B) also contained cholesterol in all tissues. In only 2 tissues of insects reared on diet B (gastric caeca and midintestine) does cholesterol account for a smaller percentage of the total sterol content than in the diet itself (5%); in all other tissues the percentage of cholesterol is equal (Malpighian tubules) or considerably higher (fat body, muscle, cuticle, ventral nerve cord) than that of the diet. Proportions of free and esterified cholesterol vary according to the tissue on diet A, but cholesterol in the tissues is almost entirely unesterified on diet B. On diet B the esterified sterol fraction is almost wholly cholestanol. The minimum essential cholesterol requirement of this insect is not completely metabolized. (CA 56: 1962, 7822f)

375 Clayton, R.B., Edwards, A.M., Bloch, K. BIOSYNTHESIS OF CHOLESTEROL IN AN INSECT, SILVERFISH. Nature, Lond. 195 (1962) 1125-6.

Non-sterile Ctenolepisma at various stages of growth were maintained for 7 months under ordinary laboratory conditions. At the end of this time the insects were extracted, the lipid extract hydrolyzed, and the sterol fraction acetylated and subjected to chromatography. The ingestion of Na acetate-1-C^{14} by the silverfish leads to the appearance of labelled cholesterol in the tissues of the insect. No 22-dehydrocholesterol was detected. (CA 57: 1962, 17225d)

376 Clayton, R.B., Bloch, K. STEROL UTILIZATION IN THE HIDE BEETLE, Dermestes vulpinus. J. biol. Chem. 238, 2 (1963) 586-91.

The capacity of sterols of different structural types to spare the normal dietary cholesterol requirements of D. vulpinus was studied. Correlations were made between structure and cholesterol-sparing efficiency of the compounds tested, and an attempt was made to interpret the results on the basis of the assumption that there sterols are incorporated unchanged into functional spaces normally occupied by cholesterol. (In the present series of experiments the sample of $\Delta^{5,7}$-cholestadienol was commercial material, shown to be uncontaminated with cholesterol by a procedure in which the dienol was first mixed with C^{14}-labelled cholesterol and subsequently separated from it chromatographically. This material was found to be incapable of replacing cholesterol entirely, although the test had indicated that its sparing activity was complete).

377 Crone, H.D., Bridges, R.G. PHOSPHOLIPIDS OF THE HOUSEFLY (Musca domestica) STABLE TO HYDROLYSIS BY MILD ALKALI AND ACID. Biochem. J. 84 (1962) 101P.

On hydrolysis (procedure as described by Dawson in Biochem. J. 75: 1960, 45) carried out on housefly extracts, 4.6% of the phospholipid phosphorus remained lipid-bound after hydrolysis with mild alkali and mild acid. This "stable fraction" could be resolved into 2 components (method as in Biochim biophys. Acta 21: 1956, 168). Hydrolysis of the "stable fraction" with 15% (v/v) HCl in methanol for 4 h at 100°C rendered a further 3.5% of the total phospholipid phosphorus water-soluble. The specific activities of the 2 fractions of this hydrolysate were different for extracts of phospholipids from flies fed on P^{32}-labelled orthophosphate. The possible implications of the existence of these 2 fractions are discussed.

378 Crone, H.D., Bridges, R.G. THE PHOSPHOLIPIDS OF THE HOUSEFLY, Musca domestica. Biochem. J. 89 (1963) 11-21.

L-[β-C^{14}] Serine (specific radioactivity 30 μc/mg) and carrier-free P^{32}-labelled orthophosphate solution in dilute HCl (radioactivity 5 mc/ml) were available. The techniques used for labelling 1-d-old flies are described. For intra-thoracic injection, 1 μl of the orthophosphate solution (5 μc) or the serine (0.14 μc) were administered. Subsequent extraction of phospholipids, the fractionation of phospholipids on columns of silicic acid, paper chromatography and colour reactions on paper chromatograms, location of radioactive compounds, hydrolytic procedures, chemical determinations, and measurements of specific radioactivity are described in detail. The major components of the phospholipid fraction of the housefly are phosphatidylethanolamine (65% of total lipid P), phosphatidylcholine (17%), phosphatidylserine (3.5%), phosphoinositide (3%), a material believed to be a polyglycerophosphatide (5%), plasmalogen (1.3%), a glycerol ether phosphatide (1%), and sphingolipid containing P and ethanolamine (3.5%). Neither sphingomyelin nor sugar-containing lipids could be detected positively in the lipid extracts. Isotopic equilibrium between the P introduced and the P of the lipids was not obtained, even long after isotope introduction. Main differences between housefly and mammal phospholipids appear to be low plasmalogen content, absence of sphingolyelin, occurrence of a sphingolipid containing P and ethanolamine, and the predominance of phosphatidylethanolamine.

379 Dutky, R.C., Robbins, W.E., Kaplanis, J.N., Shortino, T.J. THE STEROL ESTERS OF HOUSEFLY EGGS. Comp. Biochem. Physiol. 9 (1963) 251-5.

The free sterols and sterol esters from adult female Musca domestica L. and eggs were separated by column chromatography. The sterol ester fraction accounted for about 41% of the total sterol from housefly eggs but only about 8.4% in the female flies. 4-C^{14}-cholesterol with a low specific activity (7.9 x 10^4 cpm/mg) was used as the sole source of sterol and served as a marker in the chromatographic separations. Analysis of the fatty acids from the sterol ester fraction of the eggs showed these to be composed of greater than 90% C_{16} and C_{18} mono-unsaturated fatty acids with the C_{18} acids accounting for about 78% of the total. The fatty acids from the triglyceride fraction of the eggs and female flies differed from the egg sterol esters in that they contained less unsaturation and a predominance of C_{16} fatty acids.

380 Fast, P.G., Brown, A.W.A. LIPIDS OF DDT-RESISTANT AND SUSCEPTIBLE LARVAE OF Aedes aegypti. Ann. ent. Soc. Amer. 55, 6 (1962) 663-72.

No significant difference between DDT-resistant and susceptible strains of 3 different American stocks was found in total lipid or phospholipid content of the larvae. Two DDT-resistant strains of an Asiatic stock, one developed by malathion selection, contained 10%- 25% more phospholipid than the susceptible strain, and the interstrain difference in the larval heads was even greater. However towards the end of the investigation the phospholipid content of the susceptible strain increased, to equal that of the resistant strains. Breakdown of phospholipid and total lipid was equally fast in the resistant and susceptible strains, both in DDT-contaminated and in distilled water. Isolated nerve cords of the 2 DDT-resistant Asiatic strains developed symptoms of DDT-poisoning as fast as the susceptible strain. The DDT-resistant strain developed by malathion pressure absorbed radioactive DDT one-half as fast, and retained twice as much DDT in the gut, as the susceptible strain. C^{14}-DDT ring-labelled on the para-carbons only was used. The principal fatty acid of neutral lipids and phospholipids in Aëdes aegypti was palmitoleic acid; the principal phospholipid fraction was cephalin, as in other Diptera. Two sets of experiments were made with larvae in which their phospholipid had been labelled with P^{32} (orthophosphate in rearing medium). No qualitative differences in the lipids and phospholipids were found between resistant and susceptible strains, except in one of the American stocks. (Auth.)

381 Ishii, S., Kaplanis, J.N., Robbins, W.E. DISTRIBUTION AND FATE OF 4-C^{14}-CHOLESTEROL IN THE ADULT MALE AMERICAN COKCROACH. Ann. ent. Soc. Amer. 56, 1 (1963) 115-9.

The distribution and fate of 4-C^{14}-cholesterol was studied in adult male American cockroaches (Periplaneta americana (L.)) at 1, 10, and 20 d following injection. More than 80% of the administered radioactivity was still present in the cockroaches at the end of 20 d, indicating a strict sterol economy. Exchange and transport of 4-C^{14}-cholesterol between organs and tissues were evidenced by the continuing presence of radioactive compounds in the haemolymph and changes in the concentration of C^{14} compounds in several tissues. Paper chromatographic analyses of extracts indicated the presence of free sterols, sterol esters, and more polar steroids in all the tissues examined. Free sterols were predominant, accounting for 55% to 98% of the radioactive compounds present. The highest percentage of radioactive sterol esters (44%) was found in the fat body. Polar steroids were found in low concentrations except in the midgut and hindgut, where they accounted for more than one-tenth of the total radioactivity. When the C^{14} sterols isolated from whole insects were analyzed by gas-liquid chromatography and reverse isotope dilution, greater than 97% of radioactivity was found to behave like unchanged cholesterol. (Auth.)

382 Kaplanis, J.N., Dutky, R.C., Robbins, W.E. THE INCORPORATION OF 2-C^{14} - MEVALONATE INTO HOUSE FLY LIPIDS. Ann. ent. Soc. Amer. 54, 1 (1961) 114-6.

When 2-C^{14}-mevalonate was injected into male and female houseflies (Musca domestica L.) at 10 μc per fly, about the same amount of radioactivity was incorporated into the saponifiable and unsaponifiable lipids after 18 h. Fractionation of the unsaponifiable material by column chromatography demonstrated that less than 17% of the radioactive material behaved as hydrocarbons, and more than 40% was eluted in the sterol fraction. However, when this fraction was analyzed by digitonin precipitation, only trace amounts of radioactivity were precipitated with the sterol digitonides, indicating that the previously reported absence of sterol synthesis from C^{14}-acetate in the adult housefly is not due to a metabolic block in the biosynthetic pathway between acetate and mevalonate. (Auth.)

383 Kaplanis, J.N., Monroe, R.E., Robbins, W.E., Louloudes, S.J. THE FATE OF DIETARY H^3-β-SITOSTEROL IN THE ADULT HOUSE FLY. Ann. ent. Soc. Amer. 56 (1963) 198-201.

Adult houseflies (Musca domestica L.) were maintained on a semi-defined diet containing 0.1% H^3-β-sitosterol and their eggs collected over a 22-d period. Although the major portion of the radioactive compounds in both the adult flies and eggs behaved as free sterols, as much as 30% of the H^3 compounds in the eggs was esterified. Column chromatographic analyses of the free sterol and ester fractions indicated the presence of two major radioactive peaks. When the largest peak, which accounted for 88% to 95% of the total H^3 compounds, was analysed by gas-liquid chromatography and reverse-isotope dilution, more than 90% of the radioactivity was found to represent β-sitosterol. No conversion of β-sitosterol to cholesterol was detected. The minor peak, which contained 5,7-dienes, was tentatively identified as 7-dehydro-β-sitosterol. These results indicate that the housefly utilizes β-sitosterol directly and as a precursor to 7-dehydro-β-sitosterol without detectable conversion to cholesterol. (Auth.)

384 Kaplanis, J.N., Robbins, W.E., Vroman, H.E., Bryce, B.M. THE ABSENCE OF CHOLESTEROL BIOSYNTHESIS IN A PRIMITIVE INSECT; THE FIREBRAT. *Steroids* *2*, 5 (1963) 547-53.

It has been postulated that certain of the more primitive insects may be capable of residual cholesterol synthesis in contrast to the higher forms in which this capacity was lost through evolution. The recent report of high incorporation of dietary acetate-1-C^{14} into cholesterol by a silverfish merited examination in another primitive insect. Hence, several groups of *Thermobia domestica* were either fed a diet containing acetate-1-C^{14} or injected with an aqueous solution of the labelled compound. Radioanalysis of the total lipids indicated efficient incorporation of the acetate for lipid synthesis by both routes of administration. Gas-chromatographic analysis of the nonsaponifiable lipids revealed cholesterol to be the major sterol present. After the addition of purified carrier cholesterol, the sterols were isolated from the nonsaponifiable lipids by chromatography on alumina and digitonin precipitation. When the sterols from all the experiments were combined and purified through the dibromide, the cholesterol had a specific activity of 3.5 cpm/mg, yielding a total incorporation of about 39 cpm. This radioactivity represents about 0.001% of that incorporated into total lipids. (CA 60: 1964, 4511c)

385 Karlson, P., Maurer, R., Wenzel, M. A MICROMETHOD FOR LABELING STEROIDS AND ECDYSONE WITH TRITIUM. *Z. Naturf.* *18b* (1963) 219-24.

5α-Pregn-1-ene-17α,21-diol-3,11,20-trione-21 acetate and 5α-pregnane-17α,21-diol-3,11,20-trione 21-acetate were used as model compounds. Tritiation was carried out by a modified Wilzbach technique (CA 51, 10359a) at room temperature on activated C. The tritiated substances were purified by thin-layer chromatography. The method gave good specific activity with relatively small amounts of tritiated side products. A sample of ecdysone was similarly treated, but at -196°, and very low specific activity was achieved, as was also the case with the model compounds at this temperature. (CA 59: 1963, 1954e)

386 Lambremont, E.N. *In vivo* INCORPORATION OF ACETATE-1-C^{14} INTO LIPIDS BY THE BOLL WEEVIL. (Abstr.36). *Bull. ent. Soc. Amer.* *9*, 3 (1963) 162.

Adult boll weevils incorporate injected acetate-1-C^{14} into the saponifiable and nonsaponifiable lipid fractions. The incorporation ratio is approximately 9:1 in favour of the saponifiable lipids during the 2 h after injection. Silicic acid chromatography indicates higher synthesis rates in the cholesterol esters and phospholipids than in the neutral glycerides.

387 Lasser, N.L., Clayton, R.B., Edwards, A.M. THE DYNAMIC STATE OF STEROLS IN THE COCKROACH. (Abstr. 2567). *Fed. Proc.* *22*, 2 (1963) 590.

The roach, *Eurycotis/floridana*, reared aseptically on a diet containing minimal cholesterol-C^{14} (0.005%), and a cholesterol-sparing sterol (cholestanol-H^3, 0.1%), retains both sterols in its tissues in concentrations varying among the tissues, the cholesterol being virtually all unesterified and the sparing sterol both free and esterified. Individuals from a colony of such insects were analyzed when half-grown. The concentrations of esterified and free cholesterol and sparing sterol in the different tissues were determined. The remainder of the colony was allowed to grow to maturity on a diet containing the same concentrations of unlabelled sterols and were then similarly analysed. The growth of the insects during the second half of the experiment and the concentrations and specific activities of the labelled sterols remaining were considered with the aim of assessing the extent of turnover of sterols during this period. The results indicated little or no turnover of cholesterol, but considerable turnover of sparing sterol, primarily in the unesterified fraction. Displacement of labelled non-esterified sparing sterol into the esterified fraction took place during this period of growth. These results are consistent with the presence of at least 3 functionally distinct sterol pools in the tissues of this insect.

388 Louloudes, S.J., Kaplanis, J.N., Robbins, W.E., Monroe, R.E. LIPOGENESIS FROM C^{14}-ACETATE BY THE AMERICAN COCKROACH. *Ann. ent. Soc. Amer.* *54*, 1 (1961) 99-103.

Adult American cockroaches (*Periplaneta americana*) were injected with an aqueous solution of 1-C^{14}-sodium acetate and held for 24 h. On analysis, the rate of fatty acid synthesis from C^{14}-acetate was found to be 2.5 to 4.7 times greater in male than in female cockroaches. Analysis of the fatty acid methyl esters by gas-liquid chromatography demonstrated the relative distribution of radioactivity to be similar for both sexes. Both the male and female cockroaches incorporated approximately the same percentage of radioactivity into the unsaponifiable fraction. Fractionation by column chromatography demonstrated that 59% to 68% of the radioactivity behaved as hydrocarbons and 5% to 8% as sterols. None of the radioactivity in the hydrocarbon fraction behaved as squalene when analyzed by paper chromatography. Only low levels of radioactivity were found in the digitonin precipitates of the sterol fraction, none of which showed distinct peaks corresponding to either the Δ^5 or $\Delta^{5,7}$ sterol acetates following acetylation and chromatography on alumina. (Auth.)

389 Louloudes, S.J., Thompson, M.J., Monroe, R.E., Robbins, W.E. CONVERSION OF CHOLESTANOL TO Δ^7-CHOLESTENOL BY THE GERMAN COCKROACH. *Biochem. Biophys. Res. Commun.* *8*, 2 (1962) 104-6.

Reference is made to an unpublished study by Louloudes *et al.* concerned with the utilization and metabolism of dietary 4-C^{14}-cholestanol by *Blattella germanica* (L.); no conversion of cholestanol to cholesterol had been detected. However, as much as $\frac{1}{2}$ of the total C^{14} sterols isolated from the roaches was a cholestanol metabolite, which behaved as Δ^7-cholestenol when either the free sterol or its acetate was analysed by gas-liquid chromatography and reverse isotope dilution. This metabolite was also found to be formed from C^{14}-cholestanol in roaches reared under aseptic conditions. An attempt was made in the present study to identify the metabolite. Large numbers of roaches were reared on a synthetic diet containing 0.2% cholestanol and subminimal quantities of cholesterol. The extraction and subsequent analysis procedures are described. Cholestanol and Δ^7-cholestenol were identified. The significance of this conversion (of a stanol to a Δ^7-stenol) and the accumulation and function of the metabolite in the insect is not fully understood.

390 Piek, T. SYNTHESIS OF WAX IN THE HONEYBEE (*Apis mellifera*). *Proc. Acad. Sci. Amst.* Ser. C *64* (1961) 648-54. (In English).

Newly emerged bees, caged with a dead queen to stimulate comb building, were given food containing heavy water, D-labelled AcONa (I), or AcONa-1-C^{14} (II) for 2 weeks. The petroleum ether extracts of these bees and of their combs were fractionated chromatographically and the fractions examined for radioactivity. Heavy water produced no extreme differences in labelling of different lipid fractions indicating universal use of D in their synthesis. I and II failed to produce highly labelled wax esters (C_{16-24} acids and C_{24-34} alcohols) whose synthesis occurs in the combined fat cells which appear able to take up monoses from the body fluid but not AcOH, I, or II. However, I and II produced highly labelled C_{24-32} wax acids and C_{25-31} hydrocarbons, synthesis of which takes place in the oenocytes which appear able to take up acetate (or related compounds) derived from sugar degradation elsewhere. Both tissues transmit their lipid products to the wax glands. (CA 56: 1962, 14749i)

391 Rajalakshmi, S., Sarma, D.S.R.*, Sarma, P.S. BIOSYNTHESIS OF FATTY ACID IN RICE MOTH. *Indian J. exp. Biol.* *1*, 3 (1963) 155.

The involvement of biotin as a coenzyme during biosynthesis of fatty acids from acetate-1-C^{14} was demonstrated in the larvae of *Corcyra cephalonica*. (CA 59: 1963, 11945b)

392 Rajalakshmi, S., Sharma, D.S.R.*, Sharma, P.S.* CHOLESTEROL METABOLISM IN *Corcyra cephalonica*. *Indian J. exp. Biol.* *1*, 4 (1963) 186-9.

Of several compounds tested, inositol was found to reverse the cholesterol accumulation and growth inhibition induced by γ-hexachlorocyclohexane in the larvae of rice moth, *C. cephalonica*. By using labelled acetate, mevalonic acid, and ergosterol, it was demonstrated that in this insect, cholesterol synthesis was absent and that ergosterol was converted to cholesterol. The experiments suggested a key role for inositol in maintenance of normal sterol level in the larval tissues of *C. cephalonica*. (CA 60: 1964,4511a)

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* A printing error (CA) is undoubtedly responsible for the differences in second and third authors in 391 and 392.

393 Robbins, W.E., Kaplanis, J.N., Monroe, R.E., Tabor, L.A. THE UTILIZATION OF DIETARY CHOLESTEROL BY GERMAN COCKROACHES. Ann. ent. Soc. Amer. 54, 2 (1961) 165-8.

The absorption and metabolism of 4-C^{14}-cholesterol by nymphal German cockroaches (Blattella germanica (L.)) was studied after two weeks on diets containing 0.05% C^{14}-cholesterol with and without the sterol antagonist, cholesteryl chloride, at a 1:10 ratio. Dietary cholesterol was efficiently utilized when fed alone, with greater than 90% of the ingested sterol retained. Cholesteryl chloride caused only about a 9% to 11% decrease in cholesterol utilization, as determined from the relative amounts of C^{14} compounds present in the roaches and their excreta. About 93% of the C^{14} compounds from the roaches behaved chromatographically as free sterols, 5% as esters, and the remainder as more polar compounds. Analyses of the free and esterified sterols by column chromatography and reverse-isotope dilution demonstrated that unchanged cholesterol accounted for 95% of these fractions and another 2.5% behaved like 7-dehydrocholesterol. No significant amounts of either C^{14}-labelled bile acids or coprostanol were detected in the excreta. (Auth.)

394 Robbins, W.E., Dutky, R.C., Monroe, R.E., Kaplanis, J.N. THE METABOLISM OF H^3-β-SITOSTEROL BY THE GERMAN COCKROACH. Ann. ent. Soc. Amer. 55 (1962) 102-4.

A study was made of the metabolism of β-sitosterol by nymphal German cockroaches (Blatella germanica (L.)) held for 42 days on a synthetic diet containing 0.2% of the H^3-labelled sterol. Analysis of the total H^3-compounds from the cockroaches indicated about 93% was present as free sterols and only 6% as esters. When the Δ^5 fraction, which accounted for about 97% of the total H^3-sterols in the cockroaches, was analysed by gas chromatography and/or reverse isotope dilution, about 80% was found to be cholesterol and only about 7% behaved like unchanged β-sitosterol. These data indicate that the German cockroach has available the biochemical mechanism for the removal of the 24-ethyl group from the β-sitosterol side chain. (Auth.)

395 Robbins, W.E. STUDIES ON THE UTILIZATION, METABOLISM AND FUNCTION OF STEROLS IN THE HOUSE-FLY Musca domestica. p.269-79 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Insects generally have been found to require a dietary source of sterol for normal larval growth and metamorphosis. Our work has pointed to two additional physiological roles for sterols in M. domestica L.: (1) A dietary source of sterol is essential for sustained viable egg production in the female fly; on a sterol-deficient diet eggs are produced but hatch and viability are low. (2) Cholesterol is also involved in the mobilization and utilization of nutrient reserves associated with the initiation of ovarian maturation in the female fly. The quantitative sterol requirements for the above physiological processes and the metabolic conversions that occur during growth, metamorphosis and reproduction have been studied in this insect, using C^{14}- and H^3-labelled sterols in conjunction with a variety of analytical tools, including reverse isotope dilution, gas-liquid chromatography and spectroscopy, and employing aseptic rearing techniques and semi-defined larval and adult diets. Both C^{14}-cholesterol and H^3-β-sitosterol have been used as a source of sterol in either the larval or the adult diet, and the pattern of utilization and metabolism was found to be almost identical for these two sterols. However, there was no detectable conversion of β-sitosterol to cholesterol. Sub-minimal quantities of cholesterol have also been used in the larval diet in combination with "sparing sterols" such as cholestanol, which will fulfill in part but not entirely the sterol requirement of this insect. The utilization and fate of the "sparing sterol" has been investigated using C^{14}-cholestanol, and the metabolism of the minute quantity of essential cholesterol is currently under study using high-specific-activity C^{14}-cholesterol. Other species of insects, including the German cockroach (Blattella germanica), have been examined in relation to the patterns of utilization and the metabolic pathways for sterols found in the housefly. (Auth.)

396 Saito, M., Yamazaki, M., Kobayashi, M. STEROID BIOSYNTHESIS IN THE SILKWORM. Nature, Lond. 198 (1963) 1324.

Experiments were carried out in order to investigate whether in Bombyx mori sterol is biosynthesized from the acetate of the same precursor as in mammals, or whether the sterol biosynthesis has an intimate relation to a stage in post-embryonic development. 2-C^{14}-acetate was therefore injected into silkworm larvae, pupae, and "Dauer" pupae. Details of the technique, the stages tested and the resulting radioactivity are given. A table summarizes the incorporation of 2-C^{14}-acetate into digitonide in the silkworm. The authors suggest that C^{14}-acetate is also a precursor of sterol in the silkworm pupae. The "Dauer" pupa,

30 d old, however, either cannot synthesize sterol from C^{14}-acetate or, if such a chemical system is present, it is very weak. This fact may suggest that the brain takes part in the sterol metabolism in the silkworm.

397 Sedee, P.D.J.W. INTERMEDIARY METABOLISM IN ASEPTICALLY REARED BLOWFLY LARVAE. I. BIOSYNTHESIS OF SQUALENE AND CHOLESTEROL. Arch. int. Physiol. Biochim. 69 (1961) 284-94.

Two experiments were performed with larvae of Calliphora erythrocephala. Larvae were unable to synthesize cholesterol from acetate or to synthesize or use squalene in lieu of cholesterol for growth and development. Media with squalene and cholesterol supported growth and development. No C^{14} from acetate was found in isolated cholesterol. High radioactivity was found in the non-saponifiable fraction. (CA 56: 1962, 786e)

398 Sedee, P.D.J.W. INTERMEDIARY METABOLISM IN ASEPTICALLY REARED BLOWFLY LARVAE. II. BIOSYNTHESIS OF FATTY ACIDS AND AMINO ACIDS. Arch. int. Physiol. Biochim. 69 (1961) 295-309.

Nonessential amino acids and fatty acids in Calliphora erythrocephala were determined with tracer acetate-1-C^{14}. Fatty acid and glycerol fractions of ether-extracted, aseptically-reared larvae were used. Moderate radioactivity in isolated glycerol showed that acetic acid took part indirectly in biosynthesis. Saturated and unsaturated fatty acids were not interconvertible by hydrogenation and dehydrogenation. Degradation studies showed fatty acids were synthesized by β-condensation from two different sources of 2-C units. In isolated amino acids, heavy incorporation of C^{14} was found in glutamic and aspartic acids and alanine; lesser amounts in serine, glycine, and proline. Insignificant amounts of isotope were found in phenylalanine, tyrosine, isoleucine, leucine, valine, histidine, arginine, and lysine. Isotope distribution in glutamic and aspartic acids and alanine showed that biosynthesis was similar to mammals. The presence of isotope in C-2 of glutamic acid indicated other pathways were also used. Tyrosine was synthesized from phenylalanine and proline from glutamic acid. Serine and glycine were closely linked. (CA 56: 1962, 786f)

399 Strong, F.E. In vivo SYNTHESIS OF FATTY ACIDS BY Myzus persicae (Sulz.). (Abstr.68). Bull. ent. Soc. Amer. 8, 3 (1962) 156.

See 400.

400 Strong, F.E. FATTY ACIDS: In vivo SYNTHESIS BY THE GREEN PEACH APHID, Myzus persicae (Sulzer). Science 140, 3570 (1963) 983-4.

After feeding through an artificial membrane on an 18% sucrose solution containing either acetate-1-C^{14} or uniformly-labelled glucose-C^{14}, M. persicae incorporated 75% of the C^{14} into palmitoleic, stearic, and oleic acids. Small amounts were incorporated into myristic, linoleic, and linolenic acids; no significant amounts were incorporated into the short-chain fatty acids. (Auth.)

401 Tietz, A. FAT TRANSPORT IN THE LOCUST. J. Lipid Res. 3 (1961) 421-6.

When fat body tissue from locusts was incubated for 1 h with 0.3 μM of palmitate-1-C^{14} (I) in phosphate-saline, the fatty acid was readily taken up by the tissue. I (80-90%) in the tissue was recovered as glycerides. Glycerides were released into the medium from tissue prelabelled with I on incubation in haemolymph, and were than associated with lipoproteins, but this effect was not seen if phosphate-saline, bovine serum, or buffered albumin solutions were used as incubation media. Release of glycerides was inhibited by F^- or CN^-, and did not occur with heated haemolymph. The specific activity of the glycerides released was 10 times higher than the average specific activity of total tissue glycerides. (CA 58: 1963, 3710e)

402 Tietz, A. FAT SYNTHESIS IN CELL-FREE PREPARATIONS OF LOCUST FAT-BODY. Preprint 60, "Vth International Congress of Biochemistry, Moscow 10-16 August 1961, Symposium No.VII". 5p.

Fat-body tissue was removed from male and female locusts (Locusta migratoria) 7-14 d after the last molt, and tissue homogenates were prepared. These homogenates could synthesize fatty acids from acetate-C^{14} when supplemented with ATP, $MgCl_2$, glutathione, $KHCO_3$ and malonate. Addition of coenzyme A and triphosphopyridine nucleotides further stimulated synthesis. Malonate could not be replaced by any intermediate of the glycolytic or Krebs cycle. However, the addition of some intermediates in the presence of malonate caused further stimulation. The best results were obtained with α-ketoglutarate. A particle-free supernatant (20 000 g for 20 min) appears to contain all the systems necessary for fatty acid synthesis described elsewhere for liver and mammary gland, and here obtained from fat-body. C^{14}-labelled substrates were used to study the effects of malonate and $KHCO_3$ in the locust system. To test for a possible connection between the decarboxylation of malonate and fatty acid synthesis the incorporation of acetate-1-C^{14} and of malonate-1-C^{14} into CO_2 and fatty acids by homogenate, supernatant and particles was compared.

403 VandenHeuvel, W.J.A., Robbins, W.E., Kaplanis, J.N., Louloudes, S.J., Horning, E.C. THE MAJOR STEROL FROM CHOLESTEROL-FED AMERICAN COCKROACHES. Ann. ent. Soc. Amer. 55 (1962) 723.

The major sterol extracted from male Periplaneta americana kept for 20 d on a diet containing 0.1% cholesterol-C^{14} was identified as unchanged cholesterol by gas chromatography, infrared spectrum, optical rotation, and nuclear magnetic resonance spectrum. (CA 58: 1963, 9443g)

404 Vroman, H.E., Kaplanis, J.N., Robbins, W.E. LIPID TURNOVER IN THE AMERICAN COCKROACH. (Abstr.33). Bull. ent. Soc. Amer. 9, 3 (1963) 162.

Female Periplaneta americana L. were injected with 1-C^{14}-sodium acetate, and after certain time intervals, groups of roaches were sacrificed and the radioactivity incorporated into the lipids was measured. The turnover of several lipid fractions was studied.

405 Young, R.G. THE BIOSYNTHESIS OF BEESWAX. Life Sci. 9 (1963) 676-9.

Sodium acetate-2-C^{14} (2-4μc) was injected into the body cavity of Apis mellifera L. actively synthesizing wax. C^{14} was incorporated into the free acids and esters of the wax within a few hours. The specific activity of the wax was 5000 cpm.

406* Zebe, E.C., McShan, W.H. INCORPORATION OF ^{14}C ACETATE INTO LONG CHAIN FATTY ACIDS BY THE FAT BODY OF Prodenia eridania (Lep.). Biochim. biophys. Acta 31, 2 (1959) 513-8.

It was demonstrated that the fat body of the moth P. eridania contains a system which incorporates acetate into long chain fatty acids. It requires the presence of malonate, ATP (adenosine triphosphate), coenzyme A and glutathione or cysteine. Its properties were studied. Small amounts of fatty acids were also synthesized from glucose. The fatty acids formed by the system proved to be predominantly palmitic acid and small quantities of stearic, oleic, myristic and lauric acids. (Auth. summary)

See also:

185 Incorporation of P^{32} into the phosphorous compounds of the wax moth larvae. (Wlodawer, 1961)
187 Metabolic conversions during pupation of the Cecropia silkworm. 1. Deposition and utilization of nutrient reserves. (Bade and Wyatt, 1962)
246 Zur Biogenese des Ecdysons. I. Umwandlung von Cholesterin in Ecdyson. (An investigation of the biogenesis of ecdysone. I. Transformation of cholesterin into ecdysone). (Karlson and Hoffmeister, 1963)
281 Incorporation of ^{14}C-amino acids into protein and lipid fractions of silkworms. (Shigematsu, 1960)
314 L'utilisation de nucléosides dans l'ovaire du Grillon et ses variations au cours de l'ovogenèse. I. Incorporation dans l'ARN. (Favard-Séréno and Durand, 1963)
315 L'utilisation de nucléosides dans l'ovaire du Grillon et ses variations au cours de l'ovogenèse. II. Incorporation dans l'ADN. (Favard-Séréno and Durand, 1963)

I-B-7 ORGANIC ACIDS

407 Blair, J.A. CONVERSION OF PTEROYL-L-MONOGLUTAMIC-2-C^{14} ACID INTO ISOXANTHOPTERIN IN Drosophila melanogaster. Nature, Lond. 192 (1961) 757-8.

6-d-old larvae grown on media containing radioactive pteroyl-L-monoglutamic acid (folic acid) were allowed to pupate 48-56 h on moist filter paper. Radioactive areas from supernatant spots of ammoniated extracts of the crushed pupae were chromatographed with BuOH-HOAc-H_2O (4:1:5) on 3 mm paper. The presence of isoxanthopterin (I) and 2-amino-4-hydroxypteridine-6-carboxylic acid (II) was identified by their fluorescent characteristics at 365 mμ excitation. Further chromatographic purification of I with tert-BuOH-pyridine-H_2O (10:3:7) on 3 mm paper and quantity measurement (scintillation counting) showed it to account for 20% of the radioactive material present in the sample. Due to the wide distribution of I in nature, it is postulated that it represents the end product of folic acid catabolism. This conversion requires the presence of xanthine oxidase, and it is reported that a deficiency of this enzyme accounts for the failure of D. melanogaster mutants to metabolize I, these mutants accumulate large amounts of 2-amino-4-hydroxy-pteridine and biopterin. A proposed metabolic pathway is presented for the synthesis of biopterin from 2-amino-4-hydroxypteridine-6-carboxaldehyde in the absence of xanthine oxidase. (CA 56: 1962, 7817d)

408 Brenner-Holzach, O., Leuthardt, F. URIC ACID FORMATION FROM GLUCOSE CARBON IN Drosophila melanogaster. Preliminary report. Helv. chim. Acta 46, 4 (1963) 1426-8. (In German).

The larvae of D. melanogaster were fed with glucose-1-C^{14} or glucose-6-C^{14} and the specific activity of uric acid isolated from larvae was determined. In the purine skeleton C atoms 2 and 8 had a higher specific activity after feeding glucose-6-C^{14}. In homogenates of the larvae, glucose-1-C^{14} is more rapidly transformed into CO_2 than glucose-6-C^{14} and these atoms, therefore, differ in their contribution to the formation of activated formate. (CA 59: 1963, 6757f)

409 Hitchcock, M., Smith, J.N. DETOXICATION MECHANISMS IN THE TICK Boophilus decoloratus. Biochem. J. 87, 3 (1963) 34P-35P.

Part of the study of detoxication mechanisms consisted of injecting [C^{14}]benzoic acid, p-aminobenzoic acid or p-nitrobenzoic acid into ticks kept at 34°C. Extracts prepared after 24 h contained the N-aroyl derivatives of arginine and glutamic acid. These were identified by paper chromatography and ionophoresis, by dilution analysis of the C^{14}-labelled compounds and by conversion of the arginine derivatives into the related ornithines with arginase. When the aroyl-arginine derivatives were injected, glutamic acid derivatives were found in the extracts.

I-B-8 ANTIMETABOLITES

410 Kilgore, W.W., Painter, R.R. THE EFFECT OF 5-FLUOROURACIL ON THE VIABILITY OF HOUSE FLY EGGS. J. econ. Ent. 55, 5 (1962) 710-12.

When houseflies (Musca domestica L.) were fed a diet containing 5-fluorouracil-2-C^{14} for 36 to 48 h after emergence, a significant quantity of the antimetabolite, or a metabolic product, was incorporated into their eggs. The amount of radioactive material incorporated into the eggs was the highest in eggs deposited during the 1st day of oviposition. The viability of the eggs was very low during the first 4 d after the start of oviposition, but after the 4th day the viability increased as the amount of detectable radioactivity in the eggs decreased. (Auth.)

I-B-9 CELL, TISSUE, ORGAN

411 Treherne, J.E. RADIOISOTOPES AND THE INSECT CENTRAL NERVOUS SYSTEM. p.137-43 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency, 1962.

The influx of various radioactive compounds through the continuous cellular and fibrous membrane which envelopes the nervous system has been studied. It is currently believed that the perilemma functions as a diffusion barrier restricting the entry of such substances as Na and K ions and acetylcholine into the underlying nervous tissue. An attempt has been made to study this and other processes by investigating the uptake of C^{14}-labelled molecules in the abdominal nerve cord of the cockroach, Periplaneta americana. The biochemical events in insect nervous tissue were studied at the same time by following the metabolism of some labelled compounds in the nerve cord of the insect. Results are discussed in relation to current concepts of the physiology of the vertebrate nervous system. A better understanding of the permeability processes associated with the perilemma may help elucidate some insect toxicological problems.

412 Winteringham, F.P.W. RADIOACTIVE TRACER TECHNIQUES IN INSECT BIOCHEMISTRY. p.113-30 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960" and p.283-301 in "Radioisotopes in Tropical Medicine. Proceedings of a Symposium, Bangkok, 12-16 December 1960". Vienna, International Atomic Energy Agency, 1962.

Ways are described in which radioactive tracer techniques combined with micro-fractionation techniques such as paper chromatography have provided powerful tool for studying the biochemical problems of insect control by chemicals. An important aspect of this type of work is the separation, assay and identification of labelled compounds recovered in trace amounts from insect tissues. Automatic radiochromatographic techniques are available, and identification may be established by co-chromatography with authentic compounds and by studying the action of chemical reagents and specific enzymes on the labelled fraction. By labelling pools of related metabolites *in vivo* the effects of insecticides upon the insect may be studied. Labelled pools are formed *in vivo* by feeding or injecting insects with suitable labelled compounds. Comparison of the labelled pools formed when acetate-2-C^{14} and P^{32}-labelled PO_4^{3-} were injected into adult insects provided valuable data on the biochemistry of insect nerve and muscle. Pools of metabolites labelled with C^{14} or P^{32} have served for studying the mode of action of dieldrin and other insecticides in the insect. Thus, the organophosphorus insecticides appear to slow the rate of acetylcholine synthesis *in vivo* although they are without effect on the corresponding enzyme system. Caution is advocated in interpreting tracer experiments bearing on insect resistance problems.

413 Yudin, L.A. SALIVARY GLAND FUNCTION STUDIED BY RADIOACTIVE ISOTOPES. *Med. Radiol.*, Moscow *6*, 10 (1961) 78-85.

A review with numerous references.

414 Avery, J.A. A STUDY OF THE HAEMOCYTES OF THE GRASSHOPPER, *Melanoplus differentialis* (Thomas) (ORTHOPTERA: ACRIDIDAE). *Diss. Abstr.* *24*, 4 (1963) 1753.

Emphasis was placed in the investigation on fluctuations in the number of circulating haemocytes during post-embryonic development. Average daily haemocyte counts were made, starting within 5 h after hatching and continuing through the first 10 d of the adult. Counts were made on older adults at 5-d- and then 10-d-intervals, terminating with 100-d-old adults. That a change in haemolymph volume is not solely responsible for the observed changes in the average number of circulating haemocytes during a particular developmental stage is shown by results obtained from haemolymph volume per cent determinations made on selected days of the 6th stadium and the adult using the C^{14}-carboxyl labelled inulin dilution technique. From an average of 40.3 haemolymph volume per cent on the 1st day of the 6th stadium there is a highly significant decrease to a low of 27.1% on the 5th day. This is followed by a gradual rise to 45.6 volume per cent at the end of the stadium. At ecdysis there is a non-significant decrease to 39.0 volume per cent on the 1st day of the adult followed by a slight increase, and then a gradual decrease to around 31% on the 20th day where it remains, with some fluctuations, through the 80th day. Differential haemocyte counts made from stained smears (Giemsa) and from fresh haemolymph indicate that differential, temporary adherence of the haemocytes to tissues combined with an alteration of haemolymph volume per cent may account for the repeated pattern of change in average total haemocyte counts.

415* Bricteux-Grégoire, S., Florkin, M. CONTRIBUTIONS A LA BIOCHIMIE DU VER A SOIE. II. TENEURS D'UN TISSU DE *Bombyx mori* EN EAU INTRACELLULAIRE ET EN EAU EXTRACELLULAIRE, ET RÉPARTITION DE L'AZOTE DIALYSABLE DANS CES DEUX FRACTIONS. *Arch. int. Physiol. Biochim.* *67*, 1 (1959) 29-34.

De l'inuline-^{14}C (5 µl d'une solution contenant 245 µg d'inuline, correspondant à une radioactivité totale de 74000 cpm, mesurée au compteur sans fenêtre, à courant gazeux) a été injectée dans l'hémocoele des vers à soie au stade du 5e âge. Le tube musculo-cutané a été prélevé 20 h plus tard. L'activité totale du tissu et l'activité spécifique du plasma rapportée à sa teneur en eau, ont fourni les éléments de la détermination de l'eau extracellulaire et par conséquent de l'eau intracellulaire (eau totale - eau extracellulaire). Sa connaissance a permis de montrer que l'azote dialysable est environ deux fois plus concentré dans le liquide intracellulaire. Toutefois certains acides aminés, comme la lysine et l'histidine, existent à des concentrations beaucoup plus élevées dans le liquide extracellulaire.

416 Chandley, A.C. THE TIMING OF SPERMATOGENESIS IN *Drosophila melanogaster* USING TRITIATED THYMIDINE. (Abstr.). *Heredity* *17* (1962) 303.

See 418.

417 Chandley, A.C. THE TIMING OF SPERMATOGENESIS IN *Drosophila melanogaster* USING TRITIATED THYMIDINE. (Abstr.). *Ann. human Genet.* *25*, 4 (1962) 427.

See 418.

418 Chandley, A.C., Bateman, A.J. TIMING OF SPERMATOGENESIS IN *Drosophila melanogaster* USING TRITIATED THYMIDINE. *Nature*, Lond. *193* (1962) 299-300.

In order to time the spermatogenetic cycle directly tritiated thymidine was injected into the abdomen of newly emerged males (0.08 mm^3, with an activity of 25 µc/ml). Mating, dissecting, sectioning and staining procedures followed are described. Feulgen-stained 8 µ-sections were autoradiographed. It is concluded that the period from synthesis of DNA in the spermatocyte to insemination in continuously mated males is 10 d. Of this interval, 4 d are taken up by spermatocyte maturation and 5 d by spermiogenesis, allowing 1 d for insemination. In males which were kept unmated until the sperm sampling, the rate of maturation of spermatocytes and spermatids was the same as in continuously mated males, but labelled sperm was not detected in the ejaculate until day 11 and then contributed a much smaller fraction of the sample. A table shows the sequence of irradiated stages present in sperm samples on successive days following irradiation - provided that all sperm is inseminated as soon as it matures.

419* Davis, R.P., Schneiderman, H.A. AN AUTORADIOGRAPHIC STUDY OF WOUND HEALING IN DIAPAUSING SILKWORM PUPAE. (Abstr. 185). *Anat. Rec.* *137* (1960) 348.

To determine whether cell multiplication may play a role in wound healing in diapausing insects, autoradiographic techniques were utilized. Diapausing pupae of *Hyalophora cecropia* and *Samia cynthia* received injections of tritiated thymidine at various intervals following the infliction of a severe wound on the dorsum of the thorax. At subsequent intervals the wounded region was excised, fixed, and 5 µ thick sections of this area were prepared, placed on slides, and coated with a photographic emulsion. Examination of the preparations (developed and stained after 2 weeks) revealed that numerous epidermal cells in the wounded region had incorporated the labelled thymidine. Numerous blood cells were also labelled. Since thymidine is considered a specific precursor of DNA, DNA synthesis must have occurred. Such synthesis indicates that cell duplication plays a role in the wound healing process in these diapausing insects, despite the absence of ecdysone. (From abstr.)

420 Hamori, J. CHOLINESTERASES IN INSECT MUSCLE INNERVATION, WITH SPECIAL REFERENCE TO THE INSECTICIDAL EFFECTS OF DDT AND DFP. *Bibliogr. anat.* *2* (1961) 194-206. (In English).

Old and new data are given on cholinesterase (*I*) and similar esterases in the motor axons and motor end plates of various insect species. Histochemical evidence (discussed) indicates that the enzymes do not correspond with the forms of *I* found in vertebrates. New experiments were done on different muscles of various species of insects (including flight muscles of *Apis mellifera*) in different stages of DDT poisoning. In the early (hyperactivity) stages of poisoning, 30-60 min after applying DDT, the *I* of end plates and the thicker axons was considerably reduced in terms of K^{42} uptake of nervous and muscle tissue (quantitative data tabulated). Washing the muscles free of DDT with warm acetone completely restored enzyme activity. The toxic effect of DDT poisoning is brought about by changes in membrane permeability and not *I* inhibition. In experiments on peripheral nerves and ganglions of *Lucanus cervus* (stag beetles), *Hydrophilus fluviatilis*, *Cerambyx cerda*, and *A. mellifera* moderate DDT poisoning diminished the uptake of K^{42} but not of Na^{24} from surrounding aqueous media. However, the insecticidal effect of DFP probably results from inhibition of *I*. (CA 56: 1962, 2735f)

421 Heslop, J.P., Ray, J.W. NUCLEOTIDES AND OTHER PHOSPHORUS COMPOUNDS OF COCKROACH NERVE. *Nature*, Lond. *190* (1961) 1192-3.

An estimate was made, by the labelled pool technique, of the relative tissue concentrations of phosphorus compounds contained in the abdominal ventral cord of adult male *Periplaneta americana*. The procedure followed for extraction, analysis, and assessment are described. About 60% of the total P^{32} of the nerve is thus extracted. The total P of the abdominal nerve cord was found to be 1.41 mg/g wet weight (for method, see J. Biol. Chem. 234: 1959, 466). The approximate concentrations of the various compounds are tabulated.

422 Heslop, J.P., Ray, J.W. NUCLEOTIDES AND OTHER PHOSPHORUS COMPOUNDS OF THE COCKROACH CENTRAL NERVOUS SYSTEM. *J. Insect Physiol.* *7* (1961) 127-40.

Young adult males of *Periplaneta americana* were injected intra-abdominally with > 400 µc of carrier-free P^{32}-labelled orthophosphate, then maintained on a normal diet at 25-7°C for 7 d. Abdominal nervous tissue was then excised and extracted. Various fractions were studied by (paper and elution) chromatography and radiometric assay. Adenosine 5-mono-, di-, and tri-phosphates, cytidine 5-mono-, di-, and tri-phosphates, guanosine 5-di- and tri-phosphates, uridine 5-di- and tri-phosphates, di- and tri-phosphopyridine nucleotides (DPN, TPN), uridine diphosphoglucose, α-glycerophosphate, arginine phosphate, glucose-6-phosphate, and orthophosphate were tentatively identified and estimated in cockroach nerve. Concentrations of the various compounds in the abdominal cord were comparable to those found in mammalian nervous tissue except that the cytidine and uridine nucleotides were higher. However, the apparent concentrations of some of the phosphates varied with the method of collecting and working up the nervous tissue. The amount of phospholipid in cockroach nerve was similar to that in mammalian peripheral nerve and lobster nerve.

423 Hogan, T.W. THE ABSORPTION AND SUBSEQUENT BREAKDOWN OF UREA BY DIAPAUSING EGGS OF *Acheta commodus* (Walk.) (ORTHOPTERA: GRYLLIDAE). *Aust. J. Sci. 15*, 2 (1962) 362-70.

Solutions of C^{14}-labelled urea were applied to diapausing eggs of *Acheta* and found to be absorbed into the eggs. The initial rate of intake varied with the temperature and also with the concentration of the applied solution. Eggs containing labelled urea showed a decline in their radioactivity after their removal from the urea solution. This was found to be due to the loss of C^{14} from the eggs in the form of $C^{14}O_2$, thus indicating a breakdown of the urea after entering the egg. Since the release of ammonia would be expected to follow the breakdown of urea, the effect of ammonium compounds on diapausing eggs was tested. Ammonium oxalate (0.025-0.55 M) was found to be effective in accelerating the rate of termination of diapause. Certain other ammonium compounds were effective in preliminary trials. (From auth.)

424 Gordon, H.T., Waterhouse, D.F., Gilby, A.R. INCORPORATION OF ^{14}C-ACETATE INTO SCENT CONSTITUENTS OF THE GREEN VEGETABLE BUG. *Nature*, Lond. *197*, 4869 (1963) 818.

The contents of the scent storage sac of the green vegetable bug, *Nezara viridula* var. *smaragdula* (F.) consist of a mixture of 2 liquid phases which are easily separated. Gas chromatographic analysis showed 13 peaks. *Nezara* could be shown to be capable of incorporating acetate into the major components of the scent (including hexanal, the unknown dicarbonyl, decenal and tridecane) and does not rely on concentrating unchanged, pre-formed materials from sap of the various plants on which it feeds in order to produce its characteristic scent.

425 Grell, E.H. THE GENETICS AND BIOCHEMISTRY OF RED FAT CELLS IN *Drosophila melanogaster*. *Genetics 46* (1961) 925-33.

The red fat cells phenotype was found to have a digenic-basis. Two recessive mutations were called lys (lysine) and rc (red cells). The mutation lys, with or without rc, caused accumulation of lysine (chromatographic analysis) in larvae, pupae, and adults. A disturbance in the degradation of lysine was postulated and supported by data obtained from injection of C^{14}-lysine into lys and wild type flies. Red fat cells appeared if flies developed from starved lys larvae (without rc). (CA 56: 1962, 5239d *and* 7826d.)

426* Jacob, J., Sirlin, J.L. CELL FUNCTION IN THE OVARY OF *Drosophila*. I. DEOXYRIBONUCLEIC ACID (DNA) CLASSES IN NURSE CELL NUCLEI AS DETERMINED BY AUTORADIOGRAPHY. *Chromosoma 10* (1959) 210-28.

Adult *D. melanogaster* were fed for 2-3 d on yeast mixed with adenine-8-C^{14}. After etherization of the flies, the ovaries were fixed in alcohol lightly stained in eosin, and quickly embedded in paraffin wax. The sections of 5 μ thickness lost their eosin by hydration and were treated with ribonuclease or deoxyribonuclease in Veronal buffer. After prolonged rinsing in distilled water, the slides were coated with Kodak autoradiography film, exposed for 3-12 d, developed, again rinsed for several h, and staining with methyl green-pyronin or aqueous yellowish eosin. After treatment with both enzymes a slight black colour still remained in the egg cells, caused by labelled proteins or prosthetic nucleotides. Both grain count and background errors were subtracted from the count. Determination of DNA by counting the reduced AgBr grains over the nuclei corroborated the results of Hertwig. DNA content doubled in each stage of the nurse nuclei up to the 9th (512 n), and slightly decreases in the 10th stage. Up to the 9th stage, DNA content, nuclear volume, and ploidy run parallel. (From E.M. Sect. I 14; 1960, 3772)

427 Kilby, B.A. THE BIOCHEMISTRY OF THE INSECT FAT BODY. p.111-74 in "Advances in Insect Physiology. Vol.I". Beament, J.W.L., Treherne, J.E., Wigglesworth, V.B., Eds. New York, Academic Press. 1963.

Review article, broken down into sections dealing with the nature of the fat body, carbohydrates and their metabolism, tissue respiration, lipids and the fat body, protein and amino acid metabolism, purines and pteridines, and pigments in the fat body. The two well defined functions of the fat body, storage and intermediary metabolism, are considered. Thus, the composition of insect blood can vary between much wider limits than are permissible in mammals, homeostatic regulation being effected by such tissues as the fat body. The level of blood glucose is relatively constant; a big rise after absorption through the gut of digested carbohydrate is prevented by the rapid conversion of glucose into trehalose or glycogen by the fat body. A sharp fall in the blood trehalose concentration during periods of rapid utilization, as in flight, is prevented by an almost as rapid synthesis and release of trehalose by the fat body. Numerous radioisotope studies are cited throughout.

428 Olson, W.P., O'Brien, R.D. THE RELATION BETWEEN PHYSICAL PROPERTIES AND PENETRATION OF SOLUTES INTO COCKROACH CUTICLE. *J. Insect Physiol. 9*, 6 (1963) 777-86.

In determinations of the *in vivo* penetration of K_2HPO_4, H_3PO_4, dimethoate, paraoxon, dieldrin, and DDT (labelled with P^{32} or C^{14} and dissolved in various solvents) into the pronotum of *Periplaneta americana* from the waxy layer, it was found that the penetration followed 1st order kinetics. The rate of penetration increased with the polarity of the compounds. In certain cases, the epicuticular wax (*I*) was removed by mechanical means or the use of solvents, or both. The role of the *I* in regulating penetration was small when the solutes were topically applied in a small volume of a volatile organic solvent (such as acetone). Two functional layers of *I* were demonstrated. Dimethoate in water penetrated the cuticle slowly. Overall penetration was fastest with petroleum ether, less with acetone and with EtOH, and least with water. The kinetics of disappearance of solutes from the waxy layer are subjected to mathematical analysis and interpreted in relation to previous reports on the penetration of insecticides into the bodies of insects. (CA 60: 1964, 8384g)

429 Smith, D.S., Treherne, J.E. FUNCTIONAL ASPECTS OF THE ORGANIZATION OF THE INSECT NERVOUS SYSTEM. p.401-84 in "Advances in Insect Physiology. Vol.I". Beament, J.W.L., Treherne, J.E., Wigglesworth, V.B., Eds. New York, Academic Press. 1963.

Review articles, divided into sections dealing with the nerve sheath (the neural lamella and the perineurium), glial cells, the neurone, the neuropile, the extracellular system, and the neuromuscular junction. Close on 150 references are cited. Radioisotopes were used to measure the inulin space in the terminal abdominal ganglion of *Periplaneta americana* (C^{14}), and the efflux of Na^{24} from desheathed, terminal abdominal ganglia and whole isolated abdominal nerve cords could be shown to occur as a 2-stage process. The use of Na^{24}, Na^{22}, K^{42}, Ca^{45}, and Cl^{36} in whole isolated nerve cords indicated that the apparent concentrations of the rapidly exchanging fraction in the extracellular fluid were very different from those in the external medium. The ratio of efflux of C^{14}-inulin molecules and Na^{24} ions was shown to be similar to the ratio of their free diffusion constants. (See Treherne 1961, 1962).

430 Treherne, J.E. THE EXCHANGE AND METABOLISM OF SUGARS IN THE CENTRAL NERVOUS SYSTEM OF *Periplaneta americana* L. p.632-5 in "XI. Internationaler Kongress für Entomologie, Wien, 17. bis 25. August 1960. Verhandlungen. Band I (Symposien)". Wien, Organisationskommittee des XI. Internationalen Kongresses für Entomologie, Wien 1960. 1962. (In English).

10 μl of C^{14}-labelled glucose solution were injected into the haemolymph. Subsequent paper chromatography showed that the injected glucose was rapidly converted to trehalose, only very small amounts of glucose remaining in equilibrium with the trehalose. The rate of entry of radioactive material into the abdominal nerve cord was characterized by an initial steep rise due to the movement of a relatively small number of glucose molecules of high specific activity. The second, slower, increase represents the entry of C^{14} originating as trehalose (and glucose in equilibrium in the haemolymph). It appears that 90% of the carbohydrate material crosses the perilemma as the large trehalose molecules (ca. 7 molecules of trehalose to 1 of glucose, but since the trehalose molecules are 17 times more concentrated, individual glucose molecules must have been passing at 2.5 × the rate of trehalose). The prompt appearance of C^{14} in the C skeletons of aspartic acid, glutamic acid, and alanine represents circumstantial evidence for the existence of the Krebs tricarboxylic acid cycle enzymes in the CNS of the roach. More than $\frac{1}{2}$ the administered C^{14} was found to be incorporated as glutamic acid and glutamine, suggesting that this very reactive amino acid occupies a central position in the metabolism of the cockroach CNS.

431 Treherne, J.E. SODIUM AND POTASSIUM FLUXES IN THE ABDOMINAL NERVE CORD OF THE COCKROACH. *J. exp. Biol. 38* (1961) 315-22.

Influx of Na and K ions into the central nervous system of *Periplaneta americana* was studied by measuring the increase in radioactivity within the abdominal nerve cord following the injection of Na^{24} and K^{42} into the haemolymph. The influx of Na and K ions was approximately 320 and 312 mM/l of nerve cord H_2O/h, respectively. These values are approximately equivalent to an influx/unit area of nerve cord surface of 13.9 and 13.5 × 10^{-12} M/cm^2/sec for Na and K ions, respectively. It is suggested that a dynamic steady state rather than a static impermeability must exist across the sheath surrounding the central nervous system. (CA 55: 1961, 25070c)

432 Treherne, J.E. EXCHANGES OF SODIUM IONS IN THE CENTRAL NERVOUS SYSTEM OF AN INSECT (Periplaneta americana L.). Nature, Lond. 191 (1961) 1223-4.

The greater part of the efflux of Na^{24}, measured by determining the decline in radioactivity of isolated preparations maintained in a flowing physiological solution, was found to approximate to a simple exponential function, both for the whole nerve cord and for isolated fragments. Sodium ions thus appear to be extruded from the central nervous system by a metabolically maintained secretory mechanism which is also associated with the uptake of K ions. The rate of efflux of Na from the terminal abdominal ganglion was not appreciably affected by the removal of substantial portions of the perilemma. The rate-limiting process measured in these experiments is therefore not the ion transfer across the cellular perineurium, but the exchanges associated with some underlying cellular components of the CNS. The relatively rapid effects of the poison (2:4-dinitrophenol; cyanide) molecules and the K-free solutions on the measured effluxes from the intact abdominal nerve cord thus imply that the changes in the chemical composition of the external solution were quickly transmitted to the deeper layers of the CNS. The ionic fluxes calculated previously (see 431) are therefore an over-simplification.

433 Treherne, J.E. THE MOVEMENTS OF SODIUM IONS IN THE ISOLATED ABDOMINAL NERVE CORD OF THE COCKROACH. J. exp. Biol. 38 (1961) 629-36.

The rate of loss of Na from the abdominal nerve cord was determined by following the decline in radioactivity of Na^{24}-loaded nerve cords isolated in flowing Ringer solution. There was a rapid initial exponential decline in radioactivity which eventually gave way to a second slower phase. The initial extrusion of Na was appreciably reduced by the presence of KCN or 2,4-dinitrophenol. The rate of Na efflux was not reduced in Na-free solutions, but was decreased in the absence of external K ions. It appears that Na is extruded from the nerve cord by a metabolically maintained secretory mechanism which is also associated with the uptake of K. (CA 56: 1962, 7823f)

434 Treherne, J.E. THE EFFLUX OF SODIUM IONS FROM THE LAST ABDOMINAL GANGLION OF THE COCKROACH, Periplaneta americana L. J. exp. Biol. 38 (1961) 729-36.

The rate of loss of Na^{24} from the terminal abdominal ganglion was studied by measuring the decline in radioactivity associated with an isolated preparation maintained in flowing physiological solution. The rate of Na efflux was substantially reduced in the presence of 0.2 mM/1 dinitrophenol and in K-free solution. The extrusion of Na^{24} was not significantly affected by the removal of the fibrous and cellular sheath surrounding the ganglion. The rate-limiting process in the efflux of Na measured in the experiments was not, therefore, the transfer of ions across the nerve sheath, but an extrusion from tissues lying at a deeper level in the central nervous system. (From auth. summary)

435 Treherne, J.E. THE KINETICS OF SODIUM TRANSFER IN THE CENTRAL NERVOUS SYSTEM OF THE COCKROACH, Periplaneta americana L. J. exp. Biol. 38 (1961) 737-46.

The exchange of Na ions was studied by following the escape of Na^{24} from isolated abdominal nerve cords, single connectives and ganglia. Particular attention was paid to the initial rapid exchanges of Na. The escape of Na ions occurred as a 2-stage process, the initial rapid phase giving way to a slower exponential phase of Na loss. The fast phase of efflux was not affected by the presence of 2:4-dinitrophenol, although this poison significantly reduced the 2nd slow phase of Na extrusion. The initial fast phase is attributed to a rapid diffusion from an extracellular space, demonstrated by C^{14}-inulin; the 2nd phase is identified as the slower extrusion from the cellular components of the CNS. (From auth. summary)

436 Treherne, J.E. THE DISTRIBUTION AND EXCHANGE OF SOME IONS AND MOLECULES IN THE CENTRAL NERVOUS SYSTEM OF Periplaneta americana L. J. exp. Biol. 39, 2 (1962) 193-217.

The rapidly exchanging Na^{24} fraction was found to account ~1/3 of the Na contained in desheathed abdominal ganglia which had been labelled by injection of labelled ions into the haemolymph. This Na was associated with the extracellular spaces which, with the aid of C^{14}-inulin, were shown to contain 18.2% of the ganglion water. The extracellular Na concentration was calculated as exceeding that in the haemolymph by a factor of 1.8 and being 2.5 times greater than in the cellular fraction of the ganglion. Experiments using Na^{24}, K^{42}, Ca^{45}, Cl^{36} and H^3OH showed that the concentrations of the ions in the rapidly exchanging extracellular fractions of isolated abdominal nerve cords were different from those of the external medium. The 3 cations were maintained at considerably higher concentrations in the extracellular spaces, chloride ions being present at a much lower concentration than in the external solution. Ions were concluded to be distributed between the extracellular spaces and the external solution according to a Donnan equilibrium. The implications of the experimental results are discussed further.

437 Treherne, J.E. DISTRIBUTION OF WATER AND INORGANIC IONS IN THE CENTRAL NERVOUS SYSTEM OF AN INSECT (Periplaneta americana L.). Nature, Lond. 193 (1962) 750-2.

Na^{24}, K^{42}, Cl^{36} and Ca^{45} were used in an attempt to investigate the nature of the processes involved in the transfer and distribution of inorganic ions in the CNS of P. americana. The efflux of Na^{24} from the desheathed terminal abdominal ganglia (made radioactive by injection into the haemolymph) was found to approximate to a 2-stage process with rapid and slowly exchanging ion fractions. The rapidly exchanging fraction (identified with the ions in the extracellular spaces) represent ~1/3 of the total exchangeable Na in the ganglion. The extra-cellular space was measured by C^{14}-inulin. Calculations showed the concentration of Na ions in the extracellular fluid to exceed that of the haemolymph by a factor of 1.8 and to be 2.5 times greater than that of the cellular Na of the terminal abdominal ganglion. Observations on the concentrations of the K, Ca, and Cl ions were made using whole isolated abdominal nerve cord (nc). The efflux of tritiated water from the ligated nc also occurred as a 2-stage process. The levels of the various ions in the extracellular fluid were shown to differ markedly from those in the external medium, the cations being more and the chloride ions less concentrated. Implications are discussed.

438 Treherne, J.E. TRANSFER OF SUBSTANCES BETWEEN THE BLOOD AND CENTRAL NERVOUS SYSTEM IN VERTEBRATE AND INVERTEBRATE ANIMALS. Nature, Lond. 196 (1962) 1181-3.

Some results are summarized on the relatively simple arthropod central nervous system and considered in relation to the more complex physiological organization of the mammalian brain. Attention is paid to the exchanges of labelled (C^{14}, Na^{24}, K^{42}) sugars with the haemolymph, the size and structure of the extracellular space, and the composition of the extracellular fluid as compared with the haemolymph in the arthropod.

439 Wheeler, R.E. CHANGES IN HAEMOLYMPH VOLUME DURING THE MOULTING CYCLE OF Periplaneta americana L. (ORTHOPTERA). (Abstr.). Fed. Proc. 21, 2 (1962) 123.

The C^{14} inulin method was not suitable for determining the haemolymph volume. Large amounts of the radioactive inulin were masked by the plasma, and the data were exceedingly variable and lower than those found by other methods. With amaranth red, reliable haemolymph volumes could be determined during the last moulting cycle. Ranges and mean haemolymph volumes expressed as % body weight for each of the following stages were: (a) intermoult nymphs (11-30) 17%, (b) moulting nymphs (10-26) 14%, (c) adults at ecdysis (13-35) 21%, (d) 24 h old adults (13-19) 15%, and (e) more than 24 h old adults (14-27) 19%. The increased haemolymph volume at ecdysis is significant.

440 Wyatt, G.R., Kropf, R.B., Carey, F.G. THE CHEMISTRY OF INSECT HAEMOLYMPH. IV. ACID-SOLUBLE PHOSPHATES. J. Insect Physiol. 9, 2 (1963) 137-52.

The acid-soluble phosphate compounds in the haemolymph plasma of several lepidopterous insects have been fractionated quantitatively by ion-exchange chromatography, and the principal components identified. In Hyalophora cecropia, total acid-soluble P ranged from 26 to 44 mM, and the main components were inorganic orthophosphate, α-glycerophosphate, phosphorylcholine, and phosphorylethanolamine. Present in smaller amounts were uridine diphosphate n-acetylgalactosamine and some other uridine diphosphate derivatives. The presence of a phosphagen was also indicated. Quantitatively, orthophosphate and the basic phosphates tended to be more abundant during diapause than in the active stages, while glycerophosphate changed in the reverse manner. Injected orthophosphate-P^{32} was incorporated into the various esters at all stages, though at reduced rates during diapause; but when cell-free haemolymph was incubated with P^{32}, incorporation was negligible. In Antheraea polyphemus, Samia cynthia, and Protoparce sexta, the distribution of phosphates was similar to that in H. cecropia. In Bombyx mori, however, there was little α-glycerophosphate whereas sorbitol-6-phosphate was abundant and glucose-6-phosphate was also found. (Auth.)

See also:

23 Studies on the assimilation and excretion of labelled phosphate in aphids. (Kloft and Ehrhardt, 1962)
27 Studies on Chrysomela knabi. (Oak Ridge National Lab., Tenn., 1961)
151 Biochemistry of diapause, development, and injury in silkworm pupae. (Wyatt, 1963)

155 Uptake and elimination of cesium-137 by a grasshopper - Romalea microptera. (Crossley and Pryor, 1960)

201 Glycogen synthesis in the insect fat body. (Vardanis, 1963)

202 Biochemical changes associated with growth and development of the larval blowfly, Phormia regina, Meigen. (Wimer, 1963)

209 Autoradiographische Untersuchungen zur Dotterbildung. (Autoradiographic studies on yolk formation). (Bier, 1962)

225 Rate of equilibration of the contents of the gut of Anopheles quadrimaculatus larvae with the surrounding medium. (Friedman, 1963)

226 Glutamic acid carboxylase in the nervous tissue of insects. (Frontali, 1959).

249 Das Verhalten von freien Aminosäuren, energiereichen Phosphorsäure-Verbindungen und einigen Glykolyse- und Tricarbonsäurecyclus-Substraten in Muskeln von Locusta migratoria bei der Arbeit. (The behaviour of free amino acids, high energy phosphoric acid compounds and some glycolytic and tricarboxylic acid cycle substrates in the muscles of Locusta migratoria at work). (Kirsten et al., 1963)

252 In vitro synthesis of phosphoarginine by blowfly muscle. (Lewis and Fowler, 1962)

254 Fibroin biosynthesis in Samia ricini. (Lu and Wang, 1963)

256 The protein synthesis in silk glands. I. Transfer of radioactivity from prelabelled cell debris to particulate fractions in the cell-free systems of the posterior silk gland. (Miura et al., 1961)

257 The protein synthesis in silk glands. II. Effects of inhibitors on transfer of radioactivity and role of lipid fraction in protein synthesis. (Miura et al., 1961)

258 Protein synthesis in silk glands. III. Radioactive substances in cell debris. (Miura et al., 1962)

259 Studies on the protein synthesis in silk glands. IV. Incorporation of labelled glycine into the vesicular protein by posterior silk glands. (Miura et al., 1962)

269 Autoradiographic observations on the silk glands of Bombyx mori.

270 An autoradiographic study of protein synthesis in the cells of the fibroin portion of the silk gland in Bombyx mori. (Ramenskaya, 1962)

273 Fat body insects. Autoradiographic observations on incorporation of adenine-C^{14} and orotic acid-C^{14} in larval trophocytes of Musca domestica. (Russo-Caia, 1963)

276 Electron microscopic and some biochemical studies on the cell fractions of silk glands. (Seiichi and Shimura, 1961)

277 Biosynthesis of silk fibroin. III. In vivo incorporation of glycine-C^{14} into proteins of posterior silk gland fractions. (Seiichi and Shimura, 1961)

281 Incorporation of ^{14}C-amino acids into protein and lipid fractions of silkworms. (Shigematsu, 1960)

282 Kinetics of synthesis of fibroin in the posterior division of the silk-gland of the silkworm, Bombyx mori. (Shigematsu and Koyasako, 1962)

283 Silkworm development and silk production. (Shigematsu, 1963)

287 Pattern of protein sulfur after Feulgen hydrolysis in the salivary gland chromosomes of Drosophila melanogaster. (Sirlin and Knight, 1958)

289 Incorporation of labelled valine into the proteins of the Cecropia silkworm. (Skinner, 1963)

290 The metabolism of silk moth tissues. I. Incorporation of leucine into protein. (Stevenson and Wyatt, 1962)

293 Electron microscopic and some biochemical studies on the cell fractions of silk-glands. (Suto and Shimura, 1961)

297 Transfer of radioactivity from relabelled cell debris to particulate fractions in the posterior silk glands. (Tanaka, 1961)

299 Yellow pigments in the wings of papilionid butterflies. VI. Red pigments of the papilionid and nymphalid butterflies. (Umebachi, 1962)

300 Yellow pigments in the wings of papilionid butterflies. VII. Consideration of the nature and distribution of the wing pigments of the papilionid butterflies. (Umebachi, 1962)

303 Radiometric assay of acetylcholinesterase. (Winteringham and Disney, 1962)

304 Acetylcholinesterase activity and competitive inhibition at low substrate concentrations. (Winteringham and Disney, 1963)

312 Synthese, interzellulärer Transport, und Abbau von Ribonukleinsäure im Ovar der Stubenfliege Musca domestica. (Synthesis, intercellular transport, and breakdown of ribonucleic acid in the ovary of the housefly, Musca domestica). (Bier, 1963)

313 The synthesis of ribonucleic acid (RNA) by the ovary of the cricket. (Durand and Séréno, 1961)

321 Ribonucleic acid (RNA) metabolism in the posterior silk gland of silkworm, Bombyx mori, during the fifth instar. (Hosoda et al., 1963)

345 Incorporation of tritiated adenosine in the ovary of the cricket (Gryllus bimaculatus). (Séréno and Durand, 1960)

346 Incorporation of tritiated uridine into cricket ovaries. (Séréno and Durand, 1961)

347 Cell sites of RNA and protein syntheses in the salivary gland of Smittia (Chironomidae). (Sirlin, 1960)

348 Cell function in the ovary of Drosophila. II. Behavior of ribonucleic acid (RNA). (Sirlin and Jacob, 1960)

350 The relation of messenger to nucleolar RNA. (Sirlin et al., 1962)

401 Fat transport in the locust. (Tietz, 1961)

402 Fat synthesis in cell-free preparations of locust fat-body. (Tietz, 1961)

406 Incorporation of C^{14} acetate into long chain fatty acids by the fat body of Prodenia eridania (Lep.). (Zebe and McShan, 1959)

465 Inhibited oviposition by females of Gryllus assimilis (F.) induced by radioactive males, using L-methionine-methyl-C^{14}. (Abdel-Malek, 1961)

467 Inhibitory effect of L-methionine-methyl-C^{14} on oviposition by females of the cotton leaf worm, Prodenia litura (F.) induced by radioactive males. (Abdel-Malek, 1963)

638 The permeability of insect cuticle. (Matsumura, 1959)

1553 Diffusion of oil films over insects. (Lewis, 1962)

I-B-10 MISCELLANEOUS

441 Garey, F.G., Wyatt, G.R. PHOSPHATE COMPOUNDS IN TISSUES OF THE CECROPIA SILKMOTH DURING DIAPAUSE AND DEVELOPMENT. J. Insect Physiol. 9, 3 (1963) 317-35.

The acid-soluble phosphates from tissues of diapausing and developing pupae of the cecropia silkmoth have been analysed with a view to gaining evidence on metabolic regulation during metamorphosis. The phosphates from wing epidermis and fat body were fractionated by ion-exchange chromatography and measured directly and by isotope dilution. Results from wing epidermis were corrected for occluded haemolymph. Some measurements were also made of incorporation of injected P^{32}. Inorganic phosphate in fat body is very low (0.1 - 0.6 μM/g) and is taken up from haemolymph slowly in diapause and more rapidly in the developing adult; in wing tissue also it is lower than in the surrounding haemolymph. In both tissues, ATP : ADP ratios are high in diapause and rise little at the beginning of development, while AMP remains very low; from this, it is concluded that the limitation of biosynthetic rates in diapause is not a result of deficient oxidative phosphorylation. α-Glycerophosphate in fat body remains low during diapause and rises at the beginning of development, suggesting that diapause is not characterized by elevation of reduced coenzymes. Both tissues contain relatively high levels of uridine diphosphate sugar derivatives and UTP. In fat body, there is evidence for a phosphagen. Phosphorylethanolamine, phosphorylcholine, and glycero-phosphorylcholine are abundant in fat body, accumulating to high levels during prolonged diapause. (Auth.)

442 Hildreth, P.E., Lucchesi, J.C. LOW INCIDENCE OF POLYSPERMY IN Drosophila melanogaster AND Drosophila virilis. (Abstr.). Genetics 47, 8 (1962) 958-9.

Contrary to the widespread belief that polyspermy is a normal characteristic of fertilization in Drosophila, evidence was obtained indicating that, as a rule, only one sperm is present per fertilized egg in the two species investigated. Feulgen-stained whole mounts of freshly laid eggs were examined. In D. melanogaster, 96 eggs were found in meiotic stages; among these, 91 had a single sperm, 2 had 2 sperms, and 3 had no visible sperm. Among 127 eggs of D. virilis, 87 eggs had a single sperm, no sperm was visible in 40 eggs, and no case of polyspermy was observed. The possibility was investigated that soon after their alleged entry into the egg, the supernumerary sperms undergo some degenerative change which prevents their detection with the Feulgen technique. Drosophila melanogaster eggs, fertilized by H -thymidine labelled sperms, were collected; these eggs were sectioned, stained with Feulgen or Azur-eosin Giemsa, and processed for autoradiography. 40 eggs have been examined so far; the autoradiographic data also indicate that polyspermy is a rare event in D. melanogaster.

443 Hildreth, P.E., Lucchesi, J.C. FERTILIZATION IN Drosophila. I. EVIDENCE FOR THE REGULAR OCCURRENCE OF MONOSPERMY. Devl. Biol. 6, 2 (1963) 262-78.

Feulgen-stained whole mounts of D. melanogaster and D. virilis meiotic eggs, and serially sectioned eggs of D. melanogaster stained with Feulgen or with azur-eosin-Giemsa were examined. No polyspermy

was observed among 87 fertilized eggs of D. virilis; among 165 fertilized eggs of D. melanogaster, only 6 were found to be dispermic. An autoradiographic series in which we combined tritiated thymidine labelling and Feulgen staining of sperm fully supported the validity of the Feulgen technique as a means of determining the degree of polyspermy in Drosophila. In this series each sperm was found to be Feulgen positive and also labelled. Nineteen of 20 eggs examined were monospermic, one was dispermic. A survey of the literature dealing with insect fertilization has led us to conclude that in a large number of insect species (1) physiological polyspermy does not occur and (2) when accessory sperm do occassionally enter the egg, pathological effects of polyspermy need not be manifested. The reaction to polyspermy of these species should be considered as separate from Type I Inhibition (found in those eggs in which polyspermy is pathological) and from Type II Inhibition (found in those eggs in which polyspermy is physiological). We propose to name this reaction Type III Inhibition, with the stipulation that it does not involve a new kind of inhibitory process against polyspermy, but simply combines features of the other two types of inhibition. (Auth.)
Also published as UCRL-10538, California Univ., Berkeley. Lawrence Radiation Lab. Nov. 2, 1962, 21pp.

444 Hutchinson, P.B., Matthews, R.E.F. THE FATE OF TURNIP YELLOW MOSAIC VIRUS IN THE NON-VECTOR APHID Hyadaphis brassicae (L.). Virology 20, 1 (1963) 169-75.

A method is described for the artificial feeding of individual aphids. The stylets are placed in the bore of a small capillary tube, and the aphid is effectively immobilised in this position by securing its legs to the outside with wax. By using purified solutions of turnip yellow mosaic virus heavily labelled with P^{32} and S^{35}, it was shown that the virus enters the gut of the non-vector insect Brevicoryne (Hyadaphis) brassicae (L.) and that substantial quantities of apparently intact virus persist in the gut for periods of days. (From RAE-A 52: 1964, 318)

445 Iltis, W.G., Zweig, G. SURFACTANT IN APICAL DROP OF EGGS OF SOME CULICINE MOSQUITOES. Ann. ent. Soc. Amer. 55, 4 (1962) 409-15.

The apical drop found on the posterior end of eggs of species of Culex and Culiseta, described in the recent literature as being water, exhibit high surface activity and chemically seems to be an ester of several fatty acids. The apical drop appears to play a role in returning upset egg rafts to their normal position on the water surface. No phosphorus, i.e. phospholipids, could be detected in experiments on C. tarsalis allowed to feed on P^{32}-labelled chicken ($Na_3P^{32}O_4$) or sucrose solution containing $Na_3P^{32}O_4$ (10 μc/ml).

See also:

30 Water and food relationship of the eggs and first instar nymph of Eurygaster integriceps with the aid of P^{32}. (Quraishi, 1963)

I-C Insect Labelling

446* Андреев, С.В., Молчанова, В.А., Мартенс, Б.К. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ ДЛЯ МАРКИРОВКИ НАСЕКОМЫХ. Защ. Раст. 2 (1960) 45-7.

Andreev, S.V., Molchanova, V.A., Martens, B.K. USE OF RADIOISOTOPES FOR LABELLING INSECTS. Zashch. Rast. 2 (1960) 45-7.

447 Андреев, С.В., Молчанова, В.А., Мартенс, Б.К., Ракитин, А.А. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ ПРИ МАРКИРОВКЕ ВРЕДНОЙ ЧЕРЕПАШКИ Eurygaster integriceps Put. Энт. Обозр. 42, 1 (1963) 37-46.

Andreev, S.V., Molchanova, V.A., Martens, B.K., Rakitin, A.A. USE OF RADIOACTIVE ISOTOPES FOR TAGGING OF Eurygaster integriceps Put. (HEMIPTERA, PENTATOMIDAE). Ent. Obozr. 42, 1 (1963) 37-46.

448* Бабенко, Л.В. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ ДЛЯ МЕЧЕНИЯ КЛЕЩЕЙ. Мед. Паразит. 29, 3 (1960) 320-4.

Babenko, L.V. THE USE OF RADIOACTIVE ISOTOPES FOR LABELLING TICKS. Med. Parazit., Moscow 29, 3 (1960) 320-4.

Ecological observations on ticks with a development cycle lasting several years sometimes involve recording the same individuals in successive stages of development. A labelling method that was applied to Ixodes ricinus (L.) is described. Radioactive carbon (C^{14}) was introduced intraperitoneally as a glycine constituent into mice and a rabbit at times when larvae and nymphs of I. ricinus were engorging on them. The ticks were rendered radioactive and were still so after the next moult; the cast skins were also radioactive. The process did not affect the ticks adversely.

449* Chatterji, S., Rahalkar, G.W., Sethi, G.R., Saxena, P.N. LABELLING OF ADULTS OF Bracon brevicornis WESMAEL WITH RADIOACTIVE PHOSPHORUS. Indian J. Ent. 22, 3 (1960) 226-30.

Experiments were carried out to label adults of B. brevicornis with radioactive P. By rearing the parasites on the full-grown caterpillars of Corcyra cephalonica, made radioactive by allowing them to feed on a crushed Jowar mixed with $H_3P^{32}O_4$, radioactive adults could be obtained. The activity in the adults was lost through egg-laying and excretion. (CA 56: 1962, 13364i)

450* Cook, L.M., Kettlewell, H.B.D. RADIOACTIVE LABELING OF LEPIDOPTEROUS LARVAE; A METHOD OF ESTIMATING LATE LARVAL AND PUPAL MORTALITY IN THE WILD. Nature, Lond. 187 (1960) 301-2.

Late larval and pupal mortality was estimated in 2 different colonies of the moth Panaxia dominula (L.) at different times (1953, 1959), suggesting figures between 85% and 95%. In 1953 (Kettlewell), larvae were fed on S^{35}-labelled deadnettle (Lamium spp.), giving > 20 cpm. In the larva S^{35} was mostly internal whereas in adults it was concentrated in the wings. Labelled insects were clearly distinguishable from non-radioactive ones, the lowest count being 76 cpm above background, and marked larvae could also be recognized easily. Adults were captured as they emerged, scanned, marked with cellulose paint (one mark per capture) and released. The adults were found to lay about 200 eggs (approximately 100/individual). The population under consideration comprised 6000-8000 individuals in 1952 so that the number of larvae remaining at the time of sampling was only $\sim \frac{1}{4}$ of the total number of eggs produced. There is thus heavy mortality in the late stages of development, after an appreciable drop in numbers has already taken place. The radioisotopes technique used permits estimates which are sufficiently accurate for a thorough study of mortality in wild populations.

451* Dobson, R.M. MARKING TECHNIQUES AND THEIR APPLICATION TO THE STUDY OF SMALL TERRESTRIAL ANIMALS. p.228-39 in "Progress in Soil Zoology. Papers from a Colloquium on Research Methods Organized by the Soil Zoology Committee of the International Society of Soil Science, Rothamsted, Experimental Station, Hertfordshire, 10-14 July 1958". Murphy, P.W., Ed. London, Butterworths. 1962.

The uses of marking, also in quantitative studies, and of marking systems are reviewed. Radioactive materials for insect labelling are discussed on p.233-4 and are amply documented. Attention is also drawn to possible harmful effects of the various kinds of marking.

452 Fay, R.W., Baker, J.T., Kilpatrick, J.W. REARING AND ISOTOPIC LABELING OF Fannia canicularis. J. econ. Ent. 56, 1 (1963) 69-71.

With an initial stock of 3000 pupae and weekly additions of 1000 pupae, a colony of the little housefly, Fannia canicularis (L.), provided 8000 to 10000 eggs/d. Cultures of 1000 eggs yielded 35% pupae and 70% adult emergence with equal sex distribution. Using milk containing 2.5 mc of $P^{32}/1$ as the only food source for 24 h, adult flies gave net counts of 675 to 1375 cpm at 8 to 10 d, and were considered to be labelled satisfactorily for field dispersion studies. (Auth.)

453 Kansu, A. LABELLING METHODS OF INSECTS WITH RADIOISOTOPES. University of Ankara Yearbook of the Faculty of Agriculture 1962 (1963) 11-12. (In English).

Review article. Mechanical labelling methods (external - sticking, dipping, painting, spraying; internal - injection, insertion) and biological labelling methods (contamination of food - feeding radioactive solutions, plant and animal mediation methods; contamination of the medium) are discussed. The selection of the isotope is determined by such factors as its half-life, biological and effective half-lives, the type of emission, energy and specific activity available, and the toxicity of the label.

454* Худадов, Г.Д. РАДИОАВТОГРАФИЧЕСКИЙ МЕТОД ОБНАРУЖЕНИЯ НАСЕКОМЫХ И КЛЕЩЕЙ, МЕЧЕННЫХ РАДИОАКТИВНЫМИ ИЗОТОПАМИ. Мед. Паразит. 28, 1 (1959) 60-4. Р. Ж. Биол. №50898.1960.

Khudadov, G.D. A RADIOGRAPHICAL METHOD OF OBSERVING INSECTS AND MITES LABELLED WITH RADIOACTIVE ISOTOPES. Med. Parazit., Moscow 28, 1 (1959) 60-4. R. Zh. Biol. No.50898. 1960.

When radioactive isotopes are used in the labelling of arthropods - the radioautography method is more convenient, more reliable and less laborious than the radiometry method. Calculations are given for determining exposures insuring the preparation of clear autoradiograms with a given isotope (Ca^{45}, Fe^{59}, I^{131} or P^{32}). (BA 45: 1964, 31730)

455 Худадов, Г.Д. АППАРАТ ДЛЯ МЕЧЕНИЯ ЧЛЕНИСТОНОГИХ ПОСРЕДСТВОМ НАНЕСЕНИЯ НА НИХ РАДИОАКТИВНЫХ ИЗОТОПОВ. Бюлл. Моск. Общ. Испыт. Прир., Отд. Биол. 66, 3 (1961) 40-50.

Khudadov, G.D. AN APPARATUS FOR ARTHROPOD LABELING BY MEANS OF SPRAYING THEM WITH RADIOACTIVE ISOTOPES. Byull. mosk. Obshch. Ispӯt. Prir., Otd. biol. 66, 3 (1961) 40-50.

A special apparatus is described, designed for simple and reliable spraying and tagging of arthropods by means of aqueous solutions of radioisotopes. No preliminary anaesthetization is required; 200-300 arthropods can be labelled in 2-3 min. During the first few days following labelling there is a rapid drop in radioactivity which then levels out. Wetting does not cause insects to lose their label. Fleas, cockroaches (P^{32}, Rb^{86}, Sr^{89}), and flies (Musca domestica: P^{32}, Rb^{86}, Cd^{115}, Y^{91}, Sr^{90}, Ba^{140}, I^{131}, K^{45}) have been labelled with various radioisotopes. Best results were obtained with β-emitters of a medium energy ≥ 0.8 MeV.

456 Kurihara, T. RADIOACTIVE TAGGING OF Culex pipiens WITH P^{32}. Jap. J. sanit. Zool. 14, 1 (1963) 16-19.

457* Минго-Перес, Э., Сопрунов, Ф.Ф., Рискина, Л.П. О ПРИМЕНЕНИИ РАДИОИЗОТОПОВ ДЛЯ МАРКИРОВКИ МУХ. Мед. Паразит. 27, 1 (1958) 688-93.

Mingo-Perez, E., Soprunov, F.F., Riskina, L.P. THE USE OF RADIOISOTOPES FOR LABELLING FLIES. Med. Parazit., Moscow 27, 1 (1958) 688-93.

The rate of radioactive decay in flies was studied under field and laboratory conditions, following labelling with P^{32} ($NaH_2P^{32}O_4$), S^{35} (labelled methionine) and Fe^{59} (labelled chloride). In the laboratory, labelling was effected by feeding with labelled (30-108 μc/3.5 ml) sugar solution. In the field, breeding places (refuse bins) were treated with aqueous solutions (200 μc/2 l). Flies were trapped once a week within a 300 m radius. Experiments continued from 3 weeks to 2½ months. Flies hatching at treated sites remained radioactive for 2½ months. A positive correlation was found between the number of newly hatched and radioactive flies. The significance of the biological half-life of the radioisotopes employed is stressed, since radioactivity dropped much more rapidly than could be accounted for by normal decay.

458 Mortreuil, M., Brader, I.M. MARQUAGE RADIOACTIF DES FOURMIS DANS LES PLANTATIONS D'ANANAS. p.39-43 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

La méthode de marquage radioactif convient parfaitement pour étudier certains aspects structuraux des associations fourmis-cochenilles (Pheidole megacephala (F.) et Pseudococcus brevipes) dans les plantations d'ananas. L'apport original des radiotraceurs réside dans le fait qu'ils permettent, à l'encontre des méthodes habituelles, de visualiser sans ambiguïté et sans perturber l'équilibre écologique et démographique, les dimensions des nids et des territoires tenus sous leur dépendance. (Aut.)

459 Новокрещенова, Н.С., Солдаткин, И.С., Денисенко, Л.К., Мартенс, Л.А. ПРИМЕНЕНИЕ РАДИОАКТИВНОГО УГЛЕРОДА ДЛЯ МЕЧЕНИЯ БЛОХ. Мед. Паразит. 30, 1 (1961) 72-6.

Novokreshchenova, N.S., Soldatkin, I.S., Denisenko, L.K., Martens, L.A. USE OF RADIOACTIVE CARBON FOR THE LABELLING OF FLEAS. Med. Parazit., Moscow 30, 1 (1961) 72-6.

Fleas (Xenopsylla cheopis) were labelled with C^{14} by means of glycine or acetic acid. This was done either via the rodents' blood, with the flea feeding on it, or by direct topical application to the flea. Autoradiography was deemed most suitable for the detection of labelled fleas. When fleas were allowed to feed on mice which had been given C^{14} in a dose of 500 μc/mouse, the fleas remained labelled for 5 months. Glycine produced heavier labelling here than did acetic acid. When the radioactive substance was applied to the flea's integuments the label could be detected for 2 months.

460 Odum, E.P., Golley, F.B. RADIOACTIVE TRACERS AS AN AID TO THE MEASUREMENT OF ENERGY FLOW AT THE POPULATION LEVEL IN NATURE. p.403-10 in "Radioecology. Proceedings of 1st National Symposium on Radioecology held at Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.

Individual, population and metabolic labels by means of radioisotopes are distinguished at the ecological level. Some of the most promising uses are in studies of heterotrophs at the population level (see work with P^{32} on Lasius flavus, ref. 83). Excretion rates of radioactive tracers served as indices of energy flow. The advantages of using Zn^{65} are discussed, amongst them its 250-d half-life, its relatively slow biological excretion, and hard γ-emission. A variety of terrestrial and aquatic species were used, amongst them the insects Tenebrio molitor (adults and larvae) and Oncopeltus fasciatus, the milkweed bug (adults and nymphs). The effect of environmental temperature on the biological half-life of Zn^{65} in newly emerged Tenebrio adults (living at 10, 20, and 30°C) was tested. Excretion was consistently exponential, but the slopes varied greatly with temperature. Biological half-life was inversely related to temperature and roughly inversely proportional to expected metabolic rate at these temperatures. The excretion of assimilated Zn^{65} by egg-laying Oncopeltus is shown graphically, with large loss via the eggs and little by other means. - Excretion rate increased greatly in 2 male Oncopeltus when released out of doors. - I^{131} proved a better indicator of moulting (Tenebrio), Zn^{65} of egg laying.

461 Quraishi, M.S., Lamsachi, R.F., Ergül, C. LABORATORY STUDIES ON TAGGING OF Anopheles stephensi. J. econ. Ent. 56, 5 (1963) 672-4.

Satisfactory levels of radioactivity (ca. 4000 cpm for males and 5000 cpm for females) were obtained in adult A. stephensi Liston by rearing 500 4th-instar larvae in 1 litre of water containing 10 μc of P^{32}. Sufficient activity was thus obtained in the adult to permit their detection one month after release. The behaviour of the adults appears in no way to be affected by the isotope. To obtain a good adult yield in a desired period of time (3-5 d after radioactivation of the larvae), it was found necessary to select larvae of uniform size with the aid of a mechanical separator. Larvae passing between 1.20 mm and 1.35 mm openings were accepted.

462 Шура-Бура, Б.Л., Харламов, В.П. ПРИМЕНЕНИЕ РАДИОАВТОГРАФИИ ДЛЯ ВЫЯВЛЕНИЯ МАРКИРОВАННЫХ РАДИОАКТИВНЫМИ ИЗОТОПАМИ ЧЛЕНИСТОНОГИХ. Стр. 28-9 в сб. "Материалы Симпозиума по применению биофизики в области защиты растений". Л. 1961.

Shura-Bura, B.L., Kharlamov, V.P. THE USE OF RADIOAUTOGRAPHY FOR THE DETECTION OF ARTHROPODS LABELLED WITH RADIOACTIVE ISOTOPES. p.28-9 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961.

Labelling with radioisotopes is a useful method for studying the movements of arthropod vectors of disease, and the labelled organisms can be detected by radiometry or by radioautography, which is simpler, since the organisms (or parts of them) are merely exposed on an ordinary photographic film for 24-72 h in a simple apparatus. By this method, Xenopsylla cheopis (Roths.) and Nosopsyllus (Ceratophyllus) fasciatus (Bosc) were shown to retain P^{32} and Sr^{89} for 1 and 3 months, respectively. The fleas were labelled by feeding them on mice which had received 4 μc/g body weight. (From RAE-B 51: 1963, 212)

463 Sullivan, C.R. THE SURVIVAL OF ADULTS OF THE WHITE PINE WEEVIL, Pissodes strobi (Peck), LABELLED WITH RADIOACTIVE COBALT. Canad. Ent. 93, 1 (1961) 78-9.

Co^{60} (as cobalt nitrate in acetone) was mixed with a de Kotinsky cement-benzene solution. The mixture adhered firmly to the insect elytra. The tags are suitable for behavioral studies on dispersal. For short periods (1-2 months) survival is not seriously affected by tags containing ~250 μc or less; such tags are easily detectable at distances of about 15 feet with a portable Geiger radiation probe. For period of 9 months or more tags must be limited to about 50 μc of Co^{60}; they are still readily detectable at about 5 feet.

464 Tahmisian, T.N., Devine, R.L. PRELIMINARY EXPERIMENTS ON LABELING OF GRASSHOPPER SPERMATOGONIA WITH TRITIATED THYMIDINE. p.192-3 in "Biological and Medical Research Division". Semiannual Report, July - December 1962. ANL-6790, Argonne National Lab., Ill.

Preliminary experiments include autoradiographic studies to establish the period(s) of isotope uptake, and whether grasshopper spermatogenesis is cyclic, as in mammals. (The electron microscope is to be used for studying possible deleterious effects of the H^3-labelled thymidine). Injections of 5 μc (1 μc/μl) of aqueous H^3-thymidine were tolerated by the grasshoppers which did not, however, survive > 10 μc. Labelling was found to occur randomly in several spermatogonic cysts of a testicular follicle. Sections were exposed for ~2 weeks for autoradiography.

See also:

12 Some recent studies, involving the use of radioisotopes, of the feeding behaviour of two phytophagous insects. (Banks, 1962)

13 Field studies of the daily activity and feeding behaviour of Sunn pest, Eurygaster integriceps Put., (Hemiptera, Scutelleridae) on wheat in North Iran. (Banks et al., 1961)

35 Sur la transmission d'isotopes radio-actifs entre deux fourmilières d'espèces différentes (Formica rufa et Formica polyctena). (Chauvin et al., 1961)

47 A study on formation and transmission of glandular secretions in Formica (Hymenopt. Formicidae) by means of a radioisotope technique. (Naarman, 1963)

48 L'abeille et la radioactivité. (Nordau, 1962)

51 Use of P^{32} as an aid in biological studies of the leafhopper, Scaphoideus luteolus. (Hay and Myser, 1961)

54 Mating behaviour of Anopheles stephensi. (Quraishi and Arthur, 1963)

56 The role of radionuclides in insect behavior studies (Schmidt and Smith, 1963)

63 Some results of the use of tracer techniques in the study of plant protection. (Andreev et al., 1958)

65 Studies on the flight habits of some marked insects. (Eddy et al., 1962)

79 The use of radioactive phosphorus to follow the movement of the black currant gall mite. (Lloyd-Jones and Smith, 1961)

83 Population density of the underground ant, Lasius flavus, as determined by tagging with P^{32}. (Odum and Pontin, 1961)

87 Preliminary studies on the field movement of the olive fruit fly (Dacus oleasea (Gmel.)) by labelling a natural population with radioactive phosphorus (P^{32}). (Pelekassis et al., 1962)

88 Preliminary studies of the field movement of the olive fruit fly (Dacus oleae (Gmel.)) by labelling a natural population with radioactive phosphorus (P^{32}). (Pelekassis et al., 1963)

89 The use of radioisotopes in the marking of Eurygaster integriceps Put. (Rakitin, 1963)

95 Etude du vagabondage de Ceratitis capitata Wied. en Tunisie à l'aide de radio-isotopes. (Soria and Cline, 1959)

96 Etude des populations et de dispersion de Ceratitis capitata Wied. (Dipt. Trypetidae) en Tunisie à l'aide des radioisotopes. (Soria, 1963)

137 The use of radioisotopes in the study of helminth life cycles. (Dissanaike, 1962)

138 Use of the radioisotope of phosphorus for labelling graminivorous Noctuidae and their parasites. (Kamenkova and Molchanova, 1962)

139 Autoradiography as a method of detecting tagged rodents and their ectoparasites in a study of migration problems. (Shura-Bura and Kharlamov, 1961)

140 Application of radioactive isotopes to the study of some problems of flea ecology. II. The contact between rodents and the degree to which ectoparasites are interchanged in a population of Rhombomys opimus. (Sviridov, 1963)

152 Studies on the phosphorus-32 uptake in Schistocerca gregaria (Forsk.) and Anacridium aegyptium (L.). (Abdel-Malek and Abdel-Wahab, 1961)

168 Distribution of zinc-65 in the wasp, Habrobracon, and its effects on reproduction. (Grosch, 1962)

174 Excretion rate of radio-isotopes as indices of metabolic rates in nature; biological half-life of zinc-65 in relation to temperature, food consumption, growth and reproduction in arthropods. (Odum, 1961)

445 Surfactant in apical drop of eggs of some culicine mosquitoes. (Iltis and Zweig, 1962)

476 Certain biological effects produced in the boll weevil by tagging it with P^{32}. (Mayer and Brazzel, 1961)

482 Use of radioactive isotopes for the labelling of epidemiologically important arthropods. (Khudakov, 1959)

484 Etude sur la biologie de Mallophaga. I. Emploi de l'isotope ^{59}Fe pour déterminer la nature des aliments du pou de la poule. (Kalamarz, 1963)

489 Studies on the character and prevention of the virus disease of garden crops. II. Studies on the mechanism of aphid transmission of mosaic disease of Japanese radish, using radioactive phosphorus. (Nishi, 1959)

490 Studies on the varietal resistance of garden crops to the virus disease. V. On the course of aphids transmission of the mosaic disease of Japanese radish determined by P^{32} or S^{35} (1). (Nishizawa et al., 1958).

491 Studies on the mechanism of aphid transmission of mosaic disease of Japanese radish using radioactive phosphorus-32. (Nishizawa et al. 1959)

517 Drywood termite metabolism of Vikane fumigant as shown by labelled pool technique. (Meikle et al., 1963)

766 The application of nuclear energy to agriculture. (Boroughs, 1962)

782 The effect of ionizing radiation on the biology and ecology of Rhodnius prolixus, the principal vector of Schizotrypanum (i.e. Trypanosoma) cruzi in Venezuela. (Gomez et al. 1962)

1546 Technical problems of radioisotope measurement in insect metabolism. (Kloft, 1962)

1452 Possibilities of eradication of the Mediterranean fruit fly Geratitis capitata Wied. from Central America by gamma-irradiated males. (Katiyar, 1962)

1468 Quelques effets des rayons gamma sur la teigne de la farine et sur divers nématodes. (Brande and Pelerents, 1962)

1580 Travaux de recherches utilisant les isotopes et les rayonnements nucléaires en entomologie appliquée en France et dans les pays associés. (Pesson, 1962)

I-D Developmental and Genetic Effects Incurred through Labelling

465 Abdel-Malek, A.A., Kevan, D.K. MCE. INHIBITED OVIPOSITION BY FEMALES OF Gryllus assimilis (F.) INDUCED BY RADIOACTIVE MALES, USING L-METHIONINE-METHYL-^{14}C. Nature, Lond. 192, 4803 (1961) 681-2.

Aqueous solutions of L-methionine labelled in the methyl group with C^{14} which emits weak β-rays, were injected into the haemolymph of last-instar nymphs of the Jamaican Gryllus assimilis (F.) at rates of 0.05 - 10 μc each. Doses above 5 μc were lethal within 24 h, but nymphs with up to 5 μc completed their development and functioned normally. No eggs were laid by females (whether radioactive or normal) when mated with radioactive males although oviposition by virgins or both kinds is normal. Oviposition recommenced on mating with normal males. About 2 weeks later, radioactive females produced radioactive eggs which resulted in radioactive 1st-instar nymphs. Similar results were obtained when drinking water contained some of the radioisotope. These findings provide the first indication that sterility can be induced by so weak a source. Some factor which appears to inhibit oviposition seems to be passed to the females from the radioactive males by way of the spermatophores, found to be detectably radioactive. It seems unlikely, at present, that non-radioactive L-methionine would have this effect. This type of sterility would not appear to be exploitable against G. assimilis by the release of radioactive males since the females mate frequently, and would soon do so with normal males.

466 Abdel-Malek, A.A. THE EFFECT OF RADIOACTIVE PHOSPHORUS ON THE GROWTH AND DEVELOPMENT OF Culex pipiens molestus Forsk. (DIPTERA, CULICIDAE). Bull. ent. Res. 52, 4 (1961) 701-8.

In a study of the effect of different concentrations of P^{32} in the larval medium on the growth and development of Culex pipiens molestus Forsk., P^{32} was found to have little noticeable effect on the growth of the larvae up to a concentration of 3.0 μc of P^{32} ml, but, above this concentration, larval growth was greatly retarded. The period of larval development was increased at concentrations greater than 1.0 μc of P^{32} ml, and pupation occurred 2 weeks later than in the controls. In concentrations higher than 5.0 μc/ml, pupation was completely inhibited, larvae became sluggish, stopped feeding and finally died. The effect of P^{32} in the larval medium on the emergence and radioactivity of the resulting adults was also studied. On the basis of this study, it is recommended that, for efficient utilisation of radiophosphorus in large-scale field experiments, a concentration of P^{32} of 1.0 μc/ml be employed so that emerging adult mosquitos may be sufficiently radioactive to be readily detectable. (Auth.)

467 Abdel-Malek, A.A. INHIBITORY EFFECT OF L-METHIONINE-METHYL-^{14}C ON OVIPOSITION BY FEMALES OF THE COTTON LEAF WORM, Prodenia litura (F.), INDUCED BY RADIOACTIVE MALES. Nature, Lond. 200 (1963) 604-5.

The radioactive solution (0.05-5.0 μc/insect) was injected into the haemolymph of newly emerged moths of both sexes of Prodenia by microsyringe ("Agla" brand), inserted laterally through the intersegmental membrane between the 6th and 7th abdominal segments. These moths were then allowed to associate with controls (same age and stock) as follows: radioactive males with normal females; radioactive females with normal males; and normal females with normal males. Oviposition occurred only after radioactive males had been removed, when sterile eggs were laid 2 d later. Doses up to 1 μc had no deleterious effects on the moths. L-methionine-methyl-C^{14} appears to produce sterility in the male moth which has some (inhibitory?) effect on the female, so as to block oviposition altogether. The addition of radioactive males in the ratio of 12:1 to a normal population would prevent oviposition. The mass production of such males would, however, prove extremely laborious.

468 Erdman, H.E. EFFECTS OF Sr^{89} UPON POPULATIONS OF MEAL MOTHS. p.31-4 in "Hanford Biology Research Annual Report for 1960". HW-69500, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 10 Jan. 1961.

Populations of Ephestia, the Mediterranean flour moth, were cultured on cornmeal spiked with different concentrations of Sr^{89}. Several fitness components were measured to illustrate how insect populations react when irradiation is a chronic environmental factor. All levels of S^{89} employed in this experiment were detrimental to the developing organisms; those which attained adulthood reproduced another generation even though reduced in numbers. (Auth.)

469 Erdman, H.E. EFFECTS OF INGESTED Pu^{239} ON FECUNDITY, FERTILITY AND LIFE SPAN OF Habrobracon (HYMENOPTERA: BRACONIDAE). HW-SA-2605, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 8 June 1962. 10p.

See 470.

470 Erdman, H.E. EFFECTS OF INGESTED Pu^{239} ON FECUNDITY, FERTILITY AND LIFE SPAN OF Habrobracon (HYMENOPTERA: BRACONIDAE). Hlth Phys. 8, 6 (1962) 635-8.

Adult virgin female wasps, Habrobracon juglandis, were fed a single meal adulterated with either, 0.54, 0.16, or 0.08μc Pu^{239}/mg citrate-buffered sugar solution. Effects on fecundity, fertility, and life span were studied. The high concentration of the ingested isotope induced sterility after the 3rd day and lethality by the 8th day. The medium concentration induced temporary sterility (7th and 8th days), indicative of the radiosensitive developing egg-nurse cell syncytia in the zone of differentiation. The low concentration failed to induce sterility but reduced fecundity. Fertility, although noticeably reduced after the 6th day, increased to initial values toward the end of the experiment. Chromosomal damage is suggested to account for the differential radiosensitivity of germ cells in various stages of oögenesis. (Auth.)

471 Erdman, H.E. EFFECTS OF IRRADIATION ON THE MEDITERRANEAN MEAL MOTH Ephestia kuehniella Zeller, CULTURED ON ^{89}Sr-SPIKED FOOD. Int. J. Rad. Biol. 5, 4 (1962) 331-8.

Ephestia kuehniella Zeller was cultured on corn-meal spiked with Sr^{89} at concentrations of 0, 0.1, 0.3, 1.0, 3.0 and 5.0 μc/g of food. As the environmental radiation was increased, the adults which were subjected throughout their life-cycle produced progressively fewer progeny. 5.0 μc Sr^{89}/g food approaches the critical level which will inhibit population development. Life-span of the adults was not influenced by the experimental conditions. Delayed development occurred at all isotopic concentrations employed. The radiostrontium-content of females at the end of their life-cycle was half that of males. 24 h after eclosion, the radioactivity of the female moth was equal to, or greater than, that of corresponding males. Reproductive metabolism is offered in explanation. At the 2 highest culture levels (3 and 5 μc Sr^{89}/g), the increased number of males (homogametic sex) over females (heterogametic sex) is consistent with the radiation genetic effect of induced recessive lethals. No selective radiation effect upon the sexual capacity of gametes of the F$_1$ was indicated, since the subsequent F$_2$ sex ratio was 1:1. (Auth.)

472 Grosch, D.S. THE GENETIC AND DEVELOPMENTAL EFFECTS OF INGESTED RADIOACTIVES IN Habrobracon. ORO-378, North Carolina State College, Raleigh, 1960.

Larvae and adults of both sexes were used. The P^{32} mixture proved most deleterious when fed to adult females because it induced infecundity and sterility. Effects are traceable to 60% of a dose passing through the ovaries via egg incorporation. Although delayed development, abnormalities, and lethality can be correlated with the radioactivity of the larval food exact quantitation proved difficult. The low probability of recovering visibles in the presence of drastic lethality was another complication. The life span of fed adults was also used to reveal gross physiological damage. S^{35} and Ca^{46} only reduced differentiation and hatchability of the most sensitive cell types. A descending order of effectiveness of the isotopes was revealed corresponding to the ascending order of their physical half-lives. Relatively brief biological half-lives complicated the comparison of alkaline earth elements with other isotopes although in all cases altered egg production had a greater influence than hatchability on the number of live offspring obtained. Sr^{89} caused temporary and permanent infecundity and sterility. Radiation intensity and the effects of some chemical features of the physiological environment are also considered. The biochemical basis of restoration is attacked. Attention is paid to antimetabolites, and the effects of inorganic ions on reproductive capacity.

473 Hughes, A.M. FURTHER STUDIES OF THE EFFECTS OF DEUTERIUM AND TRITIUM ON Drosophila. p.118-9 in "Bio-organic Chemistry. Quarterly Report, September - November 1961". UCRL-10032, California. Univ., Berkeley. Lawrence Radiation Lab. 25 Jan. 1962.

A statistically significant increase in the number of unusual progeny from D$_2$O-treated males over control males of D. melanogaster was found consistently. Suggestions that part of the D$_2$O-effect might be due to the relatively high tritium content of some of the D$_2$O stock solutions were not substantiated by experiments in which controlled amounts of tritium were added to D$_2$O. However, tritium alone caused the occurrence of a mutant in two consecutive experiments. (NSA 16: 1962, 18804)

474 Kaplan, W.D., Tinderholt, V.E., Gugler, H.D., Kidd, K.K. A NON-RANDOM DISTRIBUTION OF LETHALS INDUCED BY TRITIATED THYMIDINE IN Drosophila melanogaster. (Abstr.) p.227 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 Aug. 1962". London, Silver End Documentary Publications, Ltd., 1962. *

The mutagenic action of tritiated thymidine has already been reported (Experientia 16: 1960, 67). Additional studies of induced mutations have been carried out in two ways: feeding of larvae and injection of imagoes. Autoradiographs of testes of treated males and the seminal receptacles and spermathecae of females mated with them have shown that the broods in which observed mutation rates have been found correspond with the labelled sperm generations. Sex-linked recessive lethals induced by the treatment have been located and their distribution along the X-chromosome appears to be distinctly non-random.

475 Kaplan, W.D., Gugler, H.D., Kidd, K.K. THE GENETIC EFFECTS OF LABELED DNA PRECURSORS. (Abstr. 5.33). p.66 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

Sex-linked recessive lethals have been induced in Drosophila males by feeding tritiated thymidine to larvae. In three experiments feeding was restricted to 8 h to limit the incorporation of the isotope. The most heavily labelled germ cells appeared in the brood sperm utilized for the first of three 3-d broods tested for induced lethals. In one experiment, during which larvae were permitted to feed on labelled food throughout larval life a higher frequency of labelled sperm bundles was obtained and also heavier labelling of individual sperm. Induced mutation rates reflected the degree of incorporation, and mutations were restricted to those broods with labelled sperm. The physical characteristics of the β emissions of tritium - low energy and short mean path - led us to test the distribution of the induced mutations. The pattern is non-random and differs significantly from those obtained by the use of x-irradiation. The region of the X-chromosome from 1 to 20 is relatively free of mutations, whereas the regions between 30-35, 50-55, and 60-65 have a higher number of induced lethals than would be expected at random. Mutations have also been induced by tritiated deoxycytidine. These mutants will be localized and the distribution compared to the one observed with H^3-thymidine. If the pattern of induced mutations reflects the varying frequencies of the pyrimidine bases along the length of the chromosome, the pattern induced by H^3-deoxycytidine should differ from that observed with the use of H^3-thymidine.

476 Mayer, M.S., Brazzel, J.R. CERTAIN BIOLOGICAL EFFECTS PRODUCED IN THE BOLL WEEVIL BY TAGGING IT WITH P^{32}. J. econ. Ent. 54, 6 (1961) 1197-1203.

Boll weevils (Anthonomus grandis Boheman) were tagged with P^{32} by feeding to adults in solutions or rearing them in larval diets to which H$_3$P^{32}O$_4$ had been added in varying quantities. The rates of loss of radioisotope were higher for those weevils fed P^{32} as adults than for the weevils reared on the radioactive larval diet. Studies of the effects of P^{32} on fecundity, longevity, lengths of oviposition and pre-oviposition periods disclosed that the weevils reared from radioactive larval diet were more adversely affected than the weevils fed as adults. Females reared from the two highest dosages in the diet failed to lay eggs.

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* Fully reported in April issue of Genetics, 1964.

Larval mortality increased in proportion to the amount of radioactivity in the diet, and mortality was always greater and began sooner for the weevils reared in radioactive larval diet. (Auth.)

477 Strømnaes, Ø. MUTAGENIC EFFECT OF C^{14} AND H^3 LABELLED DNA* PRECURSORS INJECTED INTO Drosophila melanogaster MALES. Canad. J. Genet. Cytol. 4 (1962) 440-6.

Four groups of D. melanogaster males were injected with C^{14}- and H^3-labelled DNA precursors. In one group the males were injected as larvae. In 3 other groups and in a control group all males were injected 6 to 24 h after emergence from the pupal case. In the control group a non-labelled DNA precursor was used. Dominant lethals measured as the frequency of non-hatched eggs seemed not to be induced by the amount of radioactivity used. There was, however, a significant increase in the frequency of sex-linked recessive lethals. The data suggest that sperm available for insemination 12 to 13 d after injection have the highest induced mutation rate. The frequency of induced dominant lethals was not raised above the control value by the same radioactive compounds, and there were no indication of brood differences.

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* deoxyribonucleic acid

478 Strømnaes, Ø., Kvelland, I. THE INDUCTION OF MINUTE MUTATIONS IN Drosophila WITH TRITIUM-LABELED THYMIDINE. Genetics 48 (1963) 1559-65.

D. melanogaster adult males were injected with tritium-labelled or unlabelled thymidine when 1 to 24 h old. $1\frac{1}{2}$ d later they were mated to a series of females, to sample sperm delivered over successive three-day periods, furnishing six 3-d broods. The injected males in the labelled series were less viable and fecund than those in the control series. The 6th brood in the labelled series had a significantly higher frequency of minutes than any other brood in either series and had the lowest frequency of wild-type males. The frequency of mosaic females and of phenotypic hemithorax flies was significantly higher in the labelled series than in the control series. (Auth.)

479 Walen, K.H. CYTOGENETIC STUDIES OF X-RAY AND INGESTED P^{32} INDUCED SEX-LINKED RECESSIVE LETHALS IN Drosophila melanogaster. Hereditas 48 (1962) 124-31.

A comparative study was made of equal numbers of sex-linked lethals induced by ingested P^{32} or x-irradiation of males of D. melanogaster. Peak production of lethals coincided within each experimental series with the period of maximum chromosome breakage. The relationship between DNA synthesis and the time of chromosome breakage was discussed. Chromosomal aberrations: deletions, translocations and inversions were recovered following treatment with either mutagen. The distribution of point mutation lethals induced on the X-chromosome by P^{32} is identical to the one found after x-ray treatment. Theories which can account for the unexpected recovery of exceptional males in cultures derived from mature sperm treatment have been discussed. (Auth. summary).

See also:

20 Hessian fly feeding studies utilizing radioisotope P-32. (Gallun and Langston, 1962)
21 Feeding habits of Hessian fly Larvae on P^{32}-labelled resistant and susceptible wheat seedlings. (Gallun and Langston, 1963)
22 Determination of facts on supplementary feeding of insects with the aid of radioactive phosphorus and its effect on the maturing of eggs of Meniscus agnatus, a parasite of Hadena basilinea Sch. (Kamenkova and Molchanova, 1962)
69 Marking and release experiments with a tropical mosquito by the use of radioisotopes. (Gillies, 1962)
70 Studies on the dispersion and survival of Anopheles gambiae Giles in East Africa, by means of marking and release experiments. (Gillies, 1961)
168 Distribution of zinc-65 in the wasp, Habrobracon, and its effects on reproduction. (Grosch, 1962)
169 The localization, persistence and resultant genetic effects in invertebrates of ingested fourth period metals in stable and radioactive forms. (Grosch, 1963)
696 Radioisotope studies of pesticide metabolism by the pineapple plant. (Gortner, 1962)
970 Induction of chromosome aberrations in the spermatocytes of grasshoppers. (Ray-Chaudhuri, 1961)

I-E Insects as Disease Vectors for

I-E-1 MAN

480 Bruce-Chwatt, L.J. SOME ENTOMOLOGICAL PROBLEMS IN TROPICAL MEDICINE. p.211-29 in "Radioisotopes in Tropical Medicine, Proceedings of a Symposium, Bangkok, 12-16 December 1960". Vienna, International Atomic Energy Agency, 1962.

Review article. Malaria, African trypanosomiasis, arthropod-borne viruses and mite typhus have been selected as examples for showing the extraordinary complexity of the epidemiology of those tropical diseases in which an insect or an acarine acts as a vector. A knowledge of the ecology of the vector provides the main clue to the long-term planning of any methods of control or eradication of the relevant disease. The particular promise of radioisotopes as tools is emphasized for the following: (1) Ecological studies (dispersal range and seasonal movements; behaviour characteristics in relation to feeding, mating, oviposition and diurnal rhythmical activity; longevity studies; population density). (2) Epidemiological studies (physiology of the vector in relation to the pathogen; vectorial capacity). (3) Studies relevant to vector control (study of the normal physiology of disease vectors; study of the metabolism of vectors resistant to insecticides; study of biophysical control methods such as release of insects sterilized through the action of ionizing radiations).

481 Jenkins, D.W. RADIOISOTOPES IN ENTOMOLOGICAL STUDIES OF ENDEMIC AND TROPICAL DISEASES. p.235-62 in "Radioisotopes in Tropical Medicine, Proceedings of a Symposium, Bangkok, 12-16 December 1960". Vienna, International Atomic Energy Agency. 1962.

About 500 publications are reviewed on uses of atomic energy in the study and control of medically-important insects and their relation to human disease. The value and practicability of radioisotopes as a research tool is discussed with relation to epidemiological studies on dispersal, migration, life history, populations, and disease transmission by arthropod vectors. The use of atomic energy in control by insecticides, irradiation and sterilization, and natural control of the arthropods are reviewed, also the uses of radioactive materials vector-host relationships. Suggestions and recommendations for new and additional studies with radioisotopes and radiation are made for work in the field of endemic and tropical diseases. Co-ordinated use of irradiation, insecticides, special chemicals and hormones, special genetic characters, and natural control of pest and disease vector arthropods is suggested. Use of irradiation in learning the genetics of medically-important insects is a promising field that may provide sterile intersexes and hybrids, genes causing abnormal sex ratios, sterility factors, and other characters that may present new methods of insect control. Radioisotopes may also be used for ecological studies on parasite and predator control of such insects. (From auth.)

See also:

33 Experiments on studying the feeding activity of fleas parasitizing Gerbillinae under natural conditions by means of radioisotopes. (Soldatkin et al., 1962)
53 Use of isotopes for investigating the behaviour and ecology of insect pests in some recent studies. (Quraishi, 1963)
137 The use of radioisotopes in the study of helminth life cycles. (Dissanaike, 1962)
782 The effect of ionizing radiation on the biology and ecology of Rhodnius prolixus, the principal vector of Schizotrypanum (i.e. Trypanosoma) cruzi in Venezuela. (Gomex et al., 1962)

482* Худадов, Г.Д. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ ДЛЯ МАРКИРОВКИ ЧЛЕНИСТОНОГИХ, ИМЕЮЩИХ ЭПИДЕМИОЛОГИЧЕСКОЕ ЗНАЧЕНИЕ. Докл. АН СССР (1959). Р.Ж.Биол. №50899 Д. 1960.

Khudadov, G.D. USE OF RADIOACTIVE ISOTOPES FOR THE LABELING OF EPIDEMIOLOGICALLY IMPORTANT ARTHROPODS. Dokl. Akad. Nauk SSSR (1959). R.Zh. Biol. No.50899 D. 1960.

I-E-2 ANIMALS

483 Bennet, G.F. USE OF P^{32} IN THE STUDY OF A POPULATION OF *Simulium rugglesi* (DIPTERA: SIMULIIDAE) IN ALGONQUIN PARK, ONTARIO. *Canad. J. Zool.* *41* (1963) 831-40.

To investigate the means by which blackflies transmit disease, P^{32}-labelling was explored. Flies were allowed to feed on ducks injected with 0.25 - 0.5 mc P^{32}. The radiation level in duck blood fluctuated for the first 28 h, then decreased until, after 186 h, the level was about 1/3 that at 1½ h. Preliminary trials indicated that ducks could be exposed to the biting activity of *S. rugglesi* at any time after isotope administration; 12 h were chosen for convenience. The blood volume ingested by flies at a meal was determined *via* the radioactivity acquired. The blood meal of 56 flies so measured averaged 1.94 (0.48 - 3.56) mm^3. The rate of loss of P^{32} from the flies exceeded that from natural decay. Presumably some loss may occur in the eggs at oviposition, as in *Aëdes aegypti.* Nearly double the isotope level would be required for future studies if a detectable level is to be maintained for > 30 d. *S. rugglesi* was shown to be a mobile, long-lived population, probably involving relatively few individuals. Taking into consideration the strong host and habitat preferences shown by this species, all factors would lead to a rapid and large building up of the infective stage of parasite (e.g. *Leucocytozoon simondi*) in the fly population.

484 Kalamarz, E. ETUDE SUR LA BIOLOGIE DE *Mallophaga*. I. EMPLOI DE L'ISOTOPE ^{59}Fe POUR DÉTERMINER LA NATURE DES ALIMENTS DU POU DE LA POULE. *Zess. Nauk. Wyz. Szkol. Rolnicz. Olszt.* *15*, 2 (1963) 247-51. (In Polish, with Russian, English and French summaries).

Le marquage du pou était effectué par voie d'injection intraveineuse de la poule avec du ^{59}Fe. L'autoradiographie était employée pour étudier les relations hôte-parasite et l'alimentation du pou qui se nourrit principalement du sang de poule.

See also:

1570 Use of radioisotopes and radiation in the control of plant and animal insect pests. (Andreev *et al.*, 1963)

I-E-3 PLANTS

485 Japan. Kyushu Agricultural Experiment Station. Plant Pathology Lab., Fukuoka. STUDIES ON THE TRANSMISSION OF VIRUS DISEASE OF CROPS. 1. ECOLOGICAL AND THERAPEUTICAL STUDIES ON THE DWARF DISEASE OF RICE PLANTS - STUDIES ON THE TRANSMISSION OF DWARF DISEASE OF RICE PLANTS. *Nucl. Sci. Abstr.*, Japan *1*, 3/4 (1962) 99-100. (In English).

The relationship between the age of rice plants at the time of inoculation and the transmission of dwarf disease by green rice leafhopper, *Nephotettix cincticeps* Uhler, was investigated by means of P^{32}. After feeding for 24 h on diseased plants cultured in a solution containing P^{32}, the insects were transferred to healthy rice plants in the 1-6 leaf stage for a test feeding period of 24 h. P^{32} transfer was greatest on rice plants at the 2nd leaf stage. Infected leafhoppers were allowed to feed on 83 species of plants. Autoradiography showed that the leafhopper transferred P^{32} to 26 species. When the insects were allowed to feed on diseased rice plant which had been labelled with S^{35} *via* the roots, S^{35} was found to accumulate in the Malpighian tubules.

486 Japan. Kyushu Agricultural Experiment Station. Plant Pathology Lab., Fukuoka. ECOLOGICAL AND THERAPEUTICAL STUDIES ON THE VIRUS DISEASES OF GARDEN CROPS - STUDIES ON THE TRANSMISSION OF PLANT VIRUSES BY APHIDS. *Nucl. Sci. Abstr.*, Japan *2*, 2 (1963) 130. (In English).

An attempt was made to establish which plants were preferred hosts of the green peach aphid, *Myzus persicae* Sulzer, carrier of the Daikon mosaic virus. Aphids were allowed to feed for 24 h on virus-diseased radish seedling which had been labelled by root absorption of P^{32}. The aphids were then transferred to 29 species of plants for test feeding, the radioactivity of the plants being tested after 24 h of feeding (by GM-counters and autoradiography). Aphids were found to transfer P^{32} particularly to the following 13 plants: *Calendula arvensis*, *Youngia japonica*, *Spinacia oleracea*, *Gomphrena globosa*, *Bellis perennis*, *Artemisia vulgaris*, *Raphanus sativus*, *Rorippa indica*, *Nicotiana tabacum*, *Viola tricolor* var. *arvensis*, *Dianthus superbus*, *Antirrhinum majus* and *Triticum aesticum*. No P^{32} was transferred to *Oryza sativa*, *Avena fatua*, *Digitaria adscendens*, *Datura stramonium*, *Salvia officinalis* and *Rosa hydrida*.

487 Maramorosch, K. ACQUISITION AND TRANSMISSION OF ASTERS YELLOWS VIRUS. *Phytopathology* *52* (1962) 1219.

Virus acquisition by aster leafhoppers (*Macrosteles fascifrons*) was found related to the site of feeding on diseased aster plants. During a 16-h day at 25°C, only 3% of the leafhoppers acquired virus from older symptomless leaves of a diseased plant, whereas 80% acquired virus from diseased flowers and 90% from leafless stems. When leafhoppers were given free access to the entire plant or when they were caged on young diseased leaves, up to 50% acquired virus in a single day. Infective leafhoppers, transferred 32 times during a 16-h day at 25°C to 640 aster seedlings, infected only 76 plants in the 1st part of the day, but 162 plants in the 2nd part. Transmission peaks were observed at 8 and 11 a.m.; and at 3, 5 and 8 p.m. Although increased transmission during the afternoon hours coincided with increased feeding activity, as shown by uptake of C^{14}-labelled glucose, no definite peaks were found in food uptake. The observed transmission peaks may indicate the existence of an independent mechanism governing virus transmission. (Auth.)

488 Maramorosch, K. ARTHROPOD TRANSMISSION OF PLANT VIRUSES. *Annu. Rev. Ent.* *8* (1963) 369-414.

Detailed review article, concluded in June 1962. Some mention of work with radioisotopes is made (see especially p.381).

489* Nishi, Y. STUDIES ON THE CHARACTER AND PREVENTION OF THE VIRUS DISEASE OF GARDEN CROPS. II. STUDIES ON THE MECHANISM OF APHID TRANSMISSION OF MOSAIC DISEASE OF JAPANESE RADISH, USING RADIOACTIVE PHOSPHORUS. *Proc. Ass. Plant Prot. Kyushu* *5* (1959) 24-25. (In Japanese).

After four species of aphids, *Myzus persicae*, *Aphis medicaginis*, *A. gossypii*, and *Macrosiphoniella sanborini* had been feeding on radish seedling affected by Daikon mosaic, the number of individuals which had tapped the sap of radish as well as the amount taken up by them were measured by using P^{32}. Experiments on the mechanism of transmission of Daikon mosaic were also carried out. The amount of sap taken up was greatly increased when the aphid had been starved for 24 h previously. About 95-100% in the case of *M. persicae*, and 90% of *M. sanborini* became infected with the mosaic virus after feeding on infected sap. *M. persicae* and *A. medicaginis* showed a high level of transmission of Daikon virus; the rate of infection was considerably lower for *A. gossypii* and *M. sanborini.*

490* Nishizawa, T., Nishi, Y., Yoshii, H. STUDIES ON THE VARIETAL RESISTANCE OF GARDEN CROPS TO THE VIRUS DISEASE. V. ON THE COURSE OF APHIDS TRANSMISSION OF THE MOSAIC DISEASE OF JAPANESE RADISH DETERMINED BY P^{32} OR S^{35} (1). *Bull. Kyushu agric. Exp. Sta.* *5* (1958) 35-40. (In Japanese, with English summary).

Four species of aphids (*Rhopalosiphum pseudobrassicae*, *Myzus persicae*, *Aphis laburni*, and *Myzocallis arundicolens*) were analyzed following 24-h-feeding on P^{32}-labelled radish (*Raphanus sativus*) seedlings, affected by Daikon mosaic. The first two species, considered main vectors, showed high counts, the last none, while *A. laburni* occupied an intermediate position. When *M. persicae* was fed on infected seedling (root-labelled with P^{32}), then on a healthy seedling for 20 min, and on another for 24 h, radioactivity was found in the plants even when infection could not be proved. When the aphid was allowed to feed on an infected plant for 24 h it was able to transmit the virus to a new host; even when preceded by starvation for 6 h at 20°C it was able to transmit P^{32} to a new host. When the aphid was fed on the leaf of radish seedling which had absorbed S^{35} for 24 h, S^{35} could be recognized in the rostrum, pharynx, salivary gland, and the alimentary canal.

491 Nishizawa, T., Nishi, Y., Kimura, T. STUDIES ON THE MECHANISM OF APHID TRANSMISSION OF MOSAIC DISEASE OF JAPANESE RADISH USING RADIOACTIVE PHOSPHORUS 32. *Virus* *9*, 2 (1959) 130-3. (In Japanese, with English summary).

The studies were carried out at 15-20°C. Aphids (*Myzus persicae* Sulz.) were allowed to feed for 5 and 10 min on virus-diseased Japanese radish (*Raphanus sativus* L.) seedling cultured in a solution containing 200 mc P^{32}/ml. They were then transferred successively to 10 healthy radish seedlings and allowed to feed for 5 and 10 min, respectively. Aphids transmitted the virus up to the 6th seedling; all 10 seedlings on which the aphids had been feeding were, however, radioactive as determined by autoradiography. Aphids which had fed for 10 min, 1 min and 30 sec, respectively were transferred successively to 8-15 healthy radish seedlings and allowed to feed for 1 min or 30 sec in each case. With only brief feeding on infected material (1 min or 30 sec) no appreciable differences could be observed between virus and P^{32} transmission.

insecticides absorb < 50% of the applied dose. Other studies have demonstrated that systemic insecticides are not readily translocated from treated leaves to new growth. Areas of future research are outlined.

498 Smith, J.N. DETOXICATION MECHANISMS. Annu. Rev. Ent. 7 (1962) 465-76.

Review article. Radioisotopes were employed in some of the studies mentioned. No particular emphasis is given to them.

499 Smith, G.N. ISOTOPE METHODS. p.325-72 in "Analytical Methods for Pesticides, Plant Growth Regulators, and Food Additives. Vol.I. Principles, Methods, and General Applications". Zweig, G., Ed. New York, Academic Press. 1963.

The article confines itself to aspects directly relevant to pesticide residue work. Separate sections deal with laboratory layout (arrangement, construction and furniture, storage of radioisotopes, radioactive waste disposal, decontamination of equipment and personnel), selection of compounds, instrumentation (counting devices: ionization chambers, G.-M. counters, windowless flow counter, gas-phase counters, immersion counters, liquid scintillation counters; ratemeters and scalers; special equipment: automatic sample changers, recorders, column monitors, detectors for radioactivity on paper strips; choice of counting technique), preparation of samples (P^{32}, S^{35}, halogens, C^{14}), counting of samples (background count, coincidence correction, self-absorption corrections, back-scattering, counting efficiency, decay corrections), reporting radioactive data, special techniques, and a glossary. The need is stressed for reporting the following factors for evaluating a pesticide experiment: 1. Compound (isotope and position of labelling, specific activity and how determined, radiochemical purity of compound and how determined, physical and chemical properties of compound). 2. Treatment of plant or animal (dosage and how applied, treatment of plant or animal during observation period, when treated and when sacrificed, how sample was stored prior to analysis). 3. Counting (technique used in preparing samples for counting and equipment used for counting, background count and standard deviation, sample count and standard deviation, corrections applied in calculating net count rate, if reported in ppm or μg calculations of count conversion to ppm or μg). 4. Isolation procedure.

500 Sun, Y.-P., Johnson, E.R. A NEW BIOASSAY TECHNIQUE, WITH SPECIAL REFERENCE TO THE SPECIFIC BIOASSAY OF DDVP INSECTICIDE. J. econ. Ent. 56, 5 (1963) 635-41.

Based on a combination of several physical properties of insecticides, a new bioassay technique has been developed. This method consists of depositing insecticide and kerosene on a filter paper in a petri dish and confining insects* in another dish separated from the first by another filter paper. At 2-h exposure and with 10 mg of kerosene in each deposit, interferences of 25 organophosphorus, 16 chlorinated, and 3 carbamate insecticides are less than 1% of apparent DDVP. Radioassay of C^{14} DDVP and gas-liquid chromatographic analysis of aldrin support the hypothesis for the mechanism of this technique. (Auth.)

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* (In the present case, Drosophila melanogaster)

501 Various. Abstracts of Papers Presented at the 7th Symposium of the Japanese Society of Entomology and Zoology, College of Agriculture, University of Tokyo, 8 April 1963. Jap. J. appl. Ent. Zool. 7, 3 (1963) 234-81. (In Japanese).

Studies are reported, many of them using radioisotopes (mostly P^{32}, C^{14}; some Br^{82}), on a variety of topics such as insect resistance to insecticides; metabolism and toxicity of insecticides in insects; physiological aspects of lipid metabolism in insects; insect dispersal; the mechanism of hatching; etc.

502 Winteringham, F.P.W. ACTION AND INACTION OF INSECTICIDES. J. roy. Soc. Arts 110 (1962) 719-37.

Review article. The author deals with such aspects as the need for more selective insecticides; the problem of insecticide resistance; the incidence of resistant insects in the field; behaviouristic resistance; physiological resistance; detoxication as a mechanism of insect resistance; mechanisms of resistance not involving enzymic detoxication; the phenomenon of cross-resistance; and the action of insecticides. Current trends and prospects are discussed, also such novel methods of chemical insect control as are represented by chemosterilants. The review is documented by 102 references which also include studies in which radioisotopes have been used.

503 Zweig, G. THE PESTICIDE RESIDUE LABORATORY. p.123-30 in "Analytical Methods for Pesticides, Plant Growth Regulators, and Food Additives. Vol.I, Principles, Methods, and General Application". Zweig, G., Ed. New York, Academic Press, 1963.

The organization of such a laboratory in terms of storage, processing and extraction, clean-up procedures, final analysis, library, and personnel is discussed. Isotope methods are mentioned briefly on p.129. If the pesticide has a reactive functional group, like carboxyl, the crude extract may be reacted with C^{14}-diazomethane, and the resultant C^{14}-methyl ester of the pesticide separated physically (e.g. by paper or gas chromatography) and counted. The counting equipment here includes a counter, scaler, and a paperstrip scanner.

See also:

150 Böcek fizyolojisi ve bilhassa toksikolojisi ile ilgili arastirmalarda radyoizotoplarin kullanilmasi. (Radioisotopes in research on insect physiology and toxicology). (Kansu, 1961)
550 Organophosphorus poisons. Anticholinesterases and related compounds. (Heath, 1961)

II-B Fumigants

II-B-a GENERAL

504 Page, A.B.P., Lubatti, O.F. FUMIGATION OF INSECTS. Annu. Rev. Ent. 8 (1963) 239-64.

Review article, with incidental mention of work in which radioisotopes were utilized.

See also:

1548 Direct elemental analysis of citrus crops by instrumental neutron activation. A rapid method for total bromide, chloride, manganese, sodium and potassium residues. (Castro and Schmitt, 1962)

II-B-b CYANIDES

505 Bond, E.J. THE ACTION OF FUMIGANTS ON INSECTS. I. THE UPTAKE OF HYDROGEN CYANIDE BY Sitophilus granarius DURING FUMIGATION. Canad. J. Zool. 39 (1961) 427-36.

An apparatus and a procedure for experimental fumigation of the insects are described, with graphs of uptake and release of HCN gas. The rate of uptake increased linearly during exposure even after lethal amounts of HCN had been taken up. The sorbed HCN was partly recoverable and partly not recoverable from the bodies of the insects. After exposure to non-fatal concentrations the insects contained some loosely-bound HCN, of which a part disappeared after a few hours. However, some HCN was recoverable even after 288 hours, during which time the compound had no obvious effects on the surviving insects. Neither rhodanese nor thiocyanate resulting from its detoxifying action could be demonstrated. On using HCN labelled with C^{14}, the resulting metabolic products were not 2-imino-4-thiazolidinecarboxylic acid, demonstrating that cystine did not detoxify the HCN. This was also the case with the desert locust Schistocerca gregaria. Detoxication mechanisms for HCN thus differ from those in mammals. (CA 55: 1961, 26289c)

506 Bond, E.J. THE ACTION OF FUMIGANTS ON INSECTS. II. THE EFFECT OF HYDROGEN CYANIDE ON THE ACTIVITY AND RESPIRATION OF CERTAIN INSECTS. Canad. J. Zool. 39 (1961) 437-44.

HCN at certain concentrations caused complete inhibition of respiration in Sitophilus granarius but not in other insects (named). S. granarius differed in its reactions to HCN and to anoxia. Those exposed to HCN showed diminished pigmentation and other changes and were more resistant to MeBr. The data indicate that HCN may act on this species by combining with cytochrome oxidase. Combination of carbohydrates with the HCN to form cyanohydrins is the possible protective mechanism. (CA 55: 1961, 26289e)

507 Bond, E.J. THE ACTION OF FUMIGANTS ON INSECTS. III. THE FATE OF HYDROGEN CYANIDE IN Sitophilus granarius (L.). Canad. J. Biochem. Physiol. 39 (1961) 1793-1802.

A study of the fate of hydrogen cyanide in fumigated S. granarius adults, using C^{14} labelled cyanide, showed that this poison became generally distributed and combined with various metabolites. Labelled carbon was found in three compounds of a trichloroacetic acid extract and in one compound of the hydrolyzed proteins and in the body fats. Only a very small amount of the C was excreted from the insect's body as CO_2, but a considerable amount was found in the excrement; 9 radioactive compounds were isolated from the water-soluble fraction of the excrement. One of these, a polypeptide, contained nearly half of the total labelled carbon that was excreted and most of the activity was present in the aspartic acid portion of the compound; thus it appears that this insect can not only excrete amino acids but also it can synthesize and use them for the elimination of cyanide from their bodies. (Auth.)

508 Tschiersch, B. THE METABOLISM OF HYDROCYANIC ACID. Flora, Jena 153, 1 (1963) 115-21. (In German).

Seedlings, 2-6 d old, of Linum usitatissimum were exposed to 98.6 μc $HC^{14}N$ in glass containers. Radioactivity appeared in the 70% EtOH-soluble fraction and in the hydrolyzate of the insoluble fraction within 10 min. After 24 h, 6.39% of the total activity was found in these fractions. After 10 min exposure, the activity was strong in asparagine and slight in aspartic acid and in 2 unidentified compounds. Only after 6 h did laminarin show activity, as did many amino acids, organic acids, and sugar. Parallel experiments were run with $C^{14}O_2$. Possible pathways of HCN assimilation are discussed. (CA 59: 1963, 9090h).

509 Андреева, О.И., Костикова, Г.И. ИЗУЧЕНИЕ РЕАКЦИЙ ИЗОТОПНОГО ОБМЕНА УГЛЕРОДА МЕЖДУ ЦИАНИСТЫМ КАЛИЕМ И КАРБОНАТАМИ И ПРИМЕНЕНИЕ ИХ ДЛЯ ПОЛУЧЕНИЯ ЦИАНИСТОГО КАЛИЯ МЕЧЕННОГО ИЗОТОПОМ C^{14}. Стр.111-22 в сб. "Радиоизотопы в физических науках и промышленности. Труды Конференции, Копенгаген, 6-17 сентября, 1960", т.3. Вена, Международное агентство по атомной энергии. 1962.

Andreeva, O.I., Kostikova, G.I. STUDY OF CARBON-ISOTOPE EXCHANGE REACTIONS BETWEEN POTASSIUM CYANIDE AND SOME CARBONATES, AND THEIR USE FOR OBTAINING C^{14}-LABELLED POTASSIUM CYANIDE. p.111-22 in "Proceedings of a Conference on Radioisotopes in the Physical Sciences and Industry, held in Copenhagen, 6-17 September, 1960". Vienna, International Atomic Energy Agency. 1962.

The isotope exchange of KCN with compounds differing greatly from it in composition and structure (e.g. carbonates of alkaline and alkali-earth metals) has been studied. The carbon-isotope exchange reaction in the $KC^{12}N$-$BaC^{14}O_3$ system was investigated at 600-800°C. At high temperatures complete exchange between these compounds can be secured. With carbonates of alkali metals the exchange reaction occurs on melting and is completed at lower temperatures. Labelled potassium cyanide was obtained by (1) the isotope exchange reaction $KC^{12}N$-$BaC^{14}O_3$ (produced in 2 h at 800°C), and (2) by separation of the mixture $KCN+BaCO_3$ through extracting the KCN with liquid ammonia in a circulating extractor. By exchanging the equimolecular quantities KCN and $BaCO_3$, potassium cyanide is obtained with a chemical yield of > 90% and a basic-substance content of 96-97%. By using $BaCO_3$ with a high specific activity (60-70 mc/g), a KCN specific activity of > 80 mc/g may be obtained. The barium carbonate depleted of C^{14} regenerates after the NH_4OH extraction without appreciable loss.

II-B-c METHYL BROMIDE AND OTHERS

510 Japan. Food Research Inst., Tokyo. STUDIES ON THE MECHANISM OF FUMIGANTS. Nucl. Sci. Abstr., Japan 1, 3/4 (1962) 74. (In English).

C^{14}-labelled methyl bromide was synthesized to determine the residue and distribution in brown rice, soybean and packaging materials after fumigation. The residual radioactivity in brown rice and soybean remained nearly constant after 1 month following fumigation. High radioactivity was found in bran and endosperm of brown rice, but less in white rice. Methylation may thus occur in brown rice and soybean. Rice bran and endosperm are rich in protein, oil and vitamin B complex. High residual radioactivity appears to be present in the protein fraction, less in the starch and only negligible amounts in the oil fraction of brown rice. Residual radioactivity in rice bran was distributed as follows: vitamin B complex 9%, protein fraction 42%, and residue 49%. The possible reaction of amino acids with methyl bromide to form their derivatives is discussed in the light of results from paper partition, chromatography, paper electrophoresis and absorption spectres. Methyl bromide was sometimes retained in packaging materials, in the order: polyethylene film,, straw of rice, cellophane, craft paper, hemp, and mylar.

511 Meikle, R.W., Stewart, D. THE RESIDUE POTENTIAL OF SULFURYL FLUORIDE, METHYL BROMIDE, AND METHANE-SULFONYL FLUORIDE IN STRUCTURAL FUMIGATIONS. J. agric. Food Chem. 10, 5 (1962) 393-7.

The syntheses of sulfuryl-S^{35} chloride, sulfuryl-S^{35} fluoride, methane-C^{14}-sulfonyl chloride, methane-C^{14}-sulfonyl fluoride and methyl-C^{14} bromide are described. Fumigation experiments were carried out on a number of different samples. Once a constant count rate was obtained after exposure under specified conditions the sample was combusted and the C^{14}-barium carbonate and S^{35}-barium sulfate counted. A comparison of the carbonate and sulfate count rates allowed estimation of final (ppm) residues and interpretation of previous count rates on the fumigated samples in these terms. The results and implications are discussed in some detail.

See also:

732 Bromine residue in wheat and milled wheat fractions fumigated with methyl bromide. (Lindgren et al., 1962)

II-B-d METHYL ISOTHIOCYANATE

512 Kötter, K., Willenbrink, J., Junkmann, K. THE DEGRADATION OF METHYL ISOTHIOCYANATE-S^{35} IN VARIOUS SOILS. Z. Pf.Krankh. 68 (1961) 407-11.

To 50 ml of a soil preparation, corresponding to 100 ml/l soil was added 0.1 ml 5% solution Me isothiocyanate-S^{35}, shaken 1 h in a sealed test tube and then stored at 18°C. The tubes were opened under MeOH saturated with NH_3, emptied, and rinsed with MeOH. The solution was shaken 3 min, then filtered, and the filter was washed with NH_3-MeOH. The filtrates contained all the Me isothiocyanate of the soil samples and only approximately 2% of the SO_4. The soil residue was treated with pH 1 HCl in water, filtered, and washed with the same. The SO_4 of the solution was precipitated as $BaSO_4$. The solution containing only nonsulfate S compounds was evaporated to dryness, taken up with 10 ml, HNO_3, cleared by additions of H_2O_2, and its SO_4 precipitated as $BaSO_4$. The insoluble soil residue was heated with Na_2O_2 and ethylene glycol. Aliquots of the $BaSO_4$ precipitates and the MeOH solutions were counted in a scintillation counter. Counts were adjusted so that the sums of the percentages were 100%. The crude sums varied over the range 85-115°. Decomposition was rapid, as previously reported, in compost and also in loam during 21 d. Steam sterilization of the soils retarded it. Degradation was slight in peat and not measureable in pure sand. (From CA 55: 1961, 23888i)

II-B-e NAPHTHALENE

513 Arias, R.O., Terriere, L.C. THE HYDROXYLATION OF NAPHTHALENE-1-C^{14} BY HOUSEFLY MICROSOMES. J. econ. Ent. 55 (1962) 925-9.

Techniques used in isolating a subcellular fraction of housefly (Musca domestica) tissue capable of converting naphthalene to 1-naphthol and 1,2-dihydro-1,2-dihydroxynaphthalene are described. Incubation conditions studied include pH, temperature, time, substrate level, microsome level, and cofactor requirements. The hydroxylating activity of housefly microsomes appears to vary with the growth and development of the life stages, with older adults exhibiting greatest activity and larvae, the least. The cofactor reduced triphosphopyridine nucleotide seems to be more critical in the microsomal activity of mature adults. (CA 58: 1963, 9450h)

514 Boose, R.B., Terriere, L.C. THE RATE OF METABOLISM OF NAPHTHALENE BY RESISTANT AND SUSCEPTIBLE HOUSE FLIES. (Abstr.26). Bull. ent. Soc. Amer. 8, 3 (1962) 154.

A non-resistant and two chlorinated-hydrocarbon-resistant strains of houseflies were compared with respect to rate of metabolism of injected naphthalene-C^{14}. Comparisons were made by C^{14} measurements after wet oxidation of insects at various intervals after injection. No differences in rate of metabolism or in nature of metabolites have been observed.

515 Schonbrod, R.D., Terriere, L.C. THE METABOLISM OF NAPHTHALENE BY HOUSE FLY MICROSOMES AND ITS INHIBITION BY INSECTICIDE SYNERGISTS. (Abstr.25). Bull. Ent. Soc. Amer. 8, 3 (1962) 154.

Microsomes prepared from housefly tissue by centrifugation convert naphthalene-C^{14} into several hydroxylated products. These primary oxidation products are further metabolized by conjugation with tissue constituents. SKF 525A and pyrethrin synergists inhibit these reactions.

516 Terriere, L.C., Boose, R.B., Roubal, W.T. THE METABOLISM OF NAPHTHALENE AND 1-NAPHTHOL BY HOUSEFLIES AND RATS. Biochem. J. 79 (1961) 620-3.

Musca domestica L. (3-4 d old, of mixed sexes) and rats were fed with [1-C^{14}] naphthalene and 1-[1-C^{14}] naphthol and the products of their metabolism examined. By paper chromatography, these products were identified as glucosiduronides of 1-naphthol, 1:2-dihydro-1:2-dihydroxynaphthalene and 1:2-dihydro-1-hydroxynaphthalene; 1-naphthylsulphate; mercapturic acid conjugates of 1-naphthol and 1:2-dihydro-1:2-dihydroxynaphthalene; free 1-naphthol and 1:2-dihydro-1:2-dihydroxynaphthalene. 2-Hydroxy-1-naphthyl sulphate may also be present. All the metabolites produced by naphthalene- and 1-naphthol-treated flies were found in the urine of rats treated with naphthalene, but only 6 were produced by rats given 1-naphthol. Metabolites not previously detected in the urine of 1-naphthol-treated rats are 1:2-dihydro-2-hydroxy-1-naphthyl glucosiduronic acid and 1-naphthylmercapturic acid. (Based on auth. summary)

See also:

635 The in vitro hydroxylation of naphthalene-1-C^{14} by housefly microsomes. (Arias, 1963)

II-B-f VIKANE

517 Meikle, R.W., Stewart, D., Globus, O.A. DRYWOOD TERMITE METABOLISM OF VIKANE FUMIGANT AS SHOWN BY LABELED POOL TECHNIQUE. J. agric. Food Chem. 11, 3 (1963) 226-30.

The mode of action of Vikane fumigant (sulfuryl fluoride) in destroying the Western drywood termite, Kalotermes minor Hagen, was investigated using the labelled-pool technique. S^{35}-labelled Vikane was used. The termites were labelled by being allowed to feed on paper towelling impregnated with sodium acetate-1-C^{14} or with P^{32}-labelled phosphate. The results strongly indicate that inorganic fluoride is the primary poison, from a consideration of the disturbances in intermediary metabolism. These disturbances were deduced from variations in the paper chromatographic spectra of the labelled metabolites isolated from fumigated and control termites.

II-B-g SULFUR DIOXIDE

518 Materna, J., Kohout, R. DIE ABSORPTION DES SCHWEFELDIOXIDS DURCH DIE FICHTE. (The absorption of sulphur dioxide by fir trees). Naturwissenschaften 50, 11 (1963) 407. (In German).

In the experiments described, 15-20-year old, healthy isolated firs were used. A well-developed branch, about 10 years old, was surrounded with a polyethylene sleeve into which a phial of $S^{35}O_2$ was broken, giving an initial concentration of 8-10 mg of SO_2/m^3 of air. After at most 90 min, the sleeve was removed and the needles tested. It was found that the needles of the treated branch had absorbed nearly the entire SO_2, and that it is translocated to a lesser extent to unfumigated needles in other parts of the tree. Its transfer to needles of new shoots is very noticeable. SO_2 is also absorbed during the night.

519 Weigl, J., Ziegler, H. DIE RÄUMLICHE VERTEILUNG VON ^{35}S UND DIE ART DER MARKIERTEN VERBINDUNGEN IN SPINATBLÄTTERN NACH BEGASUNG MIT $^{35}SO_2$. (The spatial distribution of S^{35} and the identity of the tagged compounds in leaves of spinach after treatment with $S^{35}O_2$ gas). Planta 58 (1962) 435-7. (In German).

An apparatus is described in which $S^{35}O_2$ is generated from $H_2S^{35}O_4$ in a closed system. Formation of S^{35} compounds, treatment of plants with $S^{35}O_2$, and preparation for gas chromatography are done in the closed system, which is provided with means for flushing out radioactive gas. An electrophoretic method is described for the separation of sulfite, sulfate, S-contained amino acids, and compounds in which the S was protected from oxidation by combining with ethylmaleinimide. A gas chromatographic technique is described, sensitive to 20 ppm SO_2. Pieces were cut from the leaves of spinach plants after 7 h exposure to 50 ppm $S^{35}O_2$, sectioned and fixed on microscope slides. Microautoradiography showed that S^{35} was 2-5 times as abundant in the guard cells of the stomata as in other cells of the epidermis. Some was found in the vascular tissue. The S^{35} was quickly incorporated into cysteine and glutathione as well as unidentified soluble and insoluble compounds. A considerable proportion had been oxidized to sulfate. (CA 57: 1962, 12909e).

II-B-h CARBON DISULFIDE

520* Sokolov, V.A. AN INVESTIGATION OF ISOTOPE EXCHANGE IN THE SYSTEM CS_2-S^{35} FOR THE PREPARATION OF LABELED CARBON DISULFIDE. p.367-72 in "Izotopy̆ i izlucheniya v khimii. Trudvtoroĭ Vsesoyuznoĭ nauchno-tekhnicheskoĭ konferentsii po primeneniyu radioaktivny̆kh i stabil'ny̆kh izotopov i izlucheniĭ v narodnom khozyaĭsteve i nauke, Moskva, 1957. Moskva, Izv. Akad. Nauk SSSR. 1958. (In Russian). English Translation: AEC-tr-4497.

See also:

1551 Apparatus for treating insects with radioactive fumigants. (Bond and Call, 1961)

II-C Halogenated and Other Hydrocarbons

II-C-a GENERAL

521 Hoskins, W.M. PHYSIOLOGY AND BIOCHEMISTRY OF RESISTANCE TO CHLORINATED HYDROCARBONS. p.221-6 in "XI. Internationaler Kongress für Entomologie, Wien, 17 - 25 August 1960. Verhandlungen. Band III (Symposien)". Wien, Organisationskomitee des XI. Internationalen Kongresses für Entomologie, Wien 1960. 1962. (In English).

Review article, with (incidental) mention of results obtained with radioisotopes.

II-C-b ALDRIN AND DIELDRIN

522 Gerolt, P. INFLUENCE OF RELATIVE HUMIDITY ON THE UPTAKE OF INSECTICIDES FROM RESIDUAL FILMS. Nature, Lond. 197 (1963) 721.

That the uptake of C^{14}-labelled dieldrin from glass surfaces by resistant strains of Musca domestica and Anopheles gambiae and by a normal susceptible strain of Aedes aegypti was higher at 90% relative humidity than at 10%, confirmed that the toxicant was more available under humid than under dry conditions. The same effect was noted with dieldrin-impregnated filter paper and γ-BHC and DDT on dried soils, thus suggesting the phenomenon is general. Insects that walked over the treated surfaces actively showed less humidity effect than did those remaining stationary, or nearly so, during the experiment. (CA 58: 1963, 10676a)

523 Heath, D.F. Cl^{36} DIELDRIN IN MICE. p.83-91 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

The distribution of Cl^{36}-dieldrin injected intravenously into mice (LAC grey strain) was studied. Extraction of Cl^{36}-dieldrin from tissues proved difficult, and experimental techniques are described in detail. Shortly after injection, high concentrations were found in the liver and brain, but the compound rapidly dispersed and, 24 h after injection, was mainly in the fatty tissues. Very little was excreted, some was probably metabolized. An attempt is made to relate these findings to the toxic effects. (Auth.)

524 Korte, F., Rechmeier, G. INSEKTIZIDE IM STOFFWECHSEL. I. MIKROSYNTHESE VON ALDRIN-[^{14}C] UND DIELDRIN-[^{14}C]. (Insecticides in metabolism. I. Microsynthesis of C^{14}-labelled aldrin and dieldrin). Liebigs Ann. 656 (1962) 131-5. (In German).

A method for microsynthesizing aldrin and dieldrin is described. When starting with $BaC^{14}O_3$ (specific activity 20.2 mc/mM) the total yields of labelled aldrin and dieldrin are 36% and 35%, respectively. The specific activity of the end products corresponds to the activity of the $BaC^{14}O_3$ used.

525 Korte, F., Ludwig, G., Vogel, J. INSEKTIZIDE IM STOFFWECHSEL. II. UMWANDLUNG VON ALDRIN-[^{14}C] UND DIELDRIN-[^{14}C] DURCH MIKROORGANISMEN, LEBERHOMOGENATE UND MOSKITO-LARVEN. (Insecticides in metabolism. II. Metabolism of C^{14}-labelled aldrin and C^{14}-labelled dieldrin in microorganisms, liver homogenates and mosquito larvae). Liebigs Ann. 656 (1962) 135-40. (In German).

C^{14}-labelled aldrin was absorbed by mosquito larvae (Aëdes aegypti) and microorganisms and converted not only into dieldrin but to a large extent into at least 4 other components. C^{14}-labelled dieldrin gave the same as yet unidentified conversion products. The conversions of C^{14}-labelled aldrin effected by various microorganisms are listed. C^{14}-labelled dieldrin was not effected by them. Conversions of C^{14}-labelled aldrin and dieldrin as effected by mosquito larvae are also given. A single lethal dose (~0.5 - 0.9 ppm) killed all larvae within 12-15 h, the greater part of the activity remaining in the larvae (representing 95% aldrin, 2% dieldrin, 3% metabolites), and only ~10% (representing 50% aldrin, 50% metabolites) in the aqueous phase. After several sub-lethal doses every 6-8 h, only ~½ the activity is found in the larvae and large amounts of breakdown products in the aqueous phase. If a single very low dose of aldrin or dieldrin (~½ LD_{50}) is given, only 20-25% of unchanged aldrin or dieldrin remain after 24 h and only 3-5% after 48 h. The remainder (~80%) is found as metabolites in the aqueous phase. C^{14}-labelled aldrin in concentrations of 0.4 ppm in homogenates of fresh beef liver incubated 4 h at 37°C gave 50% C^{14}-labelled dieldrin; no other conversions products were detected. C^{14}-labelled dieldrin in concentrations of 0.25 ppm treated similarly remained unconverted. Recent studies in rats have shown that mammals can convert aldrin. After an intravenous dose of C^{14}-labelled aldrin > 60% of the radioactivity was found in the faeces of the rat.

526 Korte, F., Kochen, W., Ludwig, G., Rechmeier, G., Schreiber, H.J., Stiasni, M., Vogel, J. SYNTHESEN UND UNTERSUCHUNGEN VON EINIGEN C^{14}-MARKIERTEN INSEKTIZIDEN AUS DER REIHE DER HALOGENIERTEN KOHLENWASSERSTOFFE UND DES IRIDOMYRMECINS. (Syntheses and studies on some C^{14}-labelled insecticides belonging to the halogenated hydrocarbons and on labelled Iridomyrmecin). Vortrag, Chemiedozenten-Tagung, Bonn, April 1962. (In German). An abstract was published in Angew. Chem. 74 (1962) 503.

Microsyntheses of C^{14}-labelled aldrin, dieldrin, Telodrin, heptachlor, chlordane, and Iridomyrmecin have been elaborated. Starting with labelled $BaCO_3$ (specific activity ~20 mc/mM) compounds of the same specific activity are obtained, labelled in the chlorinated ring, via hexachloro-cyclopentadiene-C^{14}. The total yields relative to $BaCO_3$ were: aldrin 36%; dieldrin 35%; Telodrin 25%; keptachlor 32%; chlordane 22%, Telodrin-1,3-C^{14} (labelled in the tetrahydrofurane ring) was synthesized with a 21% total yield, Iridomyrmecin-3-C^{14} with a 16% yield. The metabolism of the insecticides was followed in microorganisms, mosquito (Aëdes aegypti) larvae, and rats.

527 Mörsdorf, K., Ludwig, G., Vogel, J., Korte, F. DIE AUSSCHEIDUNG VON ALDRIN-C^{14} UND DIELDRIN-C^{14} SOWIE IHRER METABOLITEN DURCH DIE GALLE. (The excretion of C^{14}-labelled aldrin and dieldrin as well as their metabolites via the bile). Med. Exp. 8 (1963) 90-4. (In German, with French and English summaries).

The experiments were carried out on male white rats to which the insecticides were administered intravenously (C^{14}-labelled aldrin of a specific activity of 20.7 mc/mM: 46 γ; and C^{14}-labelled dieldrin of specific activity 20.7 mc/mM: 84 γ. Aldrin and dieldrin together with their metabolites were excreted preferentially in the bile. Aldrin was found to be converted into dieldrin and another hydrophilic metabolite in the organism. Similarly, dieldrin gave rise to a hydrophilic metabolite which, on paper chromatography, was found to be identical with the hydrophilic product obtained from aldrin.

528 Potter, C.R. PICK-UP AND PENETRATION OF DIELDRIN FROM RESIDUAL FILMS. p.142-4 in "Report of the Rothamsted Experimental Station for 1960". Harpenden, Rothamsted Experimental Station. 1961.

In order to study pick-up, distribution, and penetration of the insecticide and their bearing on its toxicity to the insect, films of Cl^{36}-labelled dieldrin were used. Adult Tenebrio molitor L. were placed on them, and insects and containers were subsequently analysed for radioactivity; 30-min and 2-h exposures to 500 γ/32.2 cm^2 at 25°C were used. At the time the insects were removed from the film, 1/6 of the dose picked up could be shown to have penetrated, 1/3 after 1½ h and 2/3 after 2½ h, ~1/10 of the total dose being lost to the container. Cl^{36}-dieldrin was not active enough to enable individual insects to be examined, and was subsequently replaced by C^{36}-dieldrin for further studies.

529 Rechmeier, G. MIKROSYNTHESEN VON C^{14}-MARKIERTEN INSEKTIZIDEN UND BIOCHEMISCHE UNTERSUCHUNGEN. (Microsyntheses of C^{14}-labelled insecticides and some biochemical studies). Thesis. Bonn. Universität. Organisch-Chemisches Institut. 1962. 66p. (In German).

C^{14}-labelled hexachlorocyclopentadiene (I) was obtained from $BaC^{14}O_3$ (specific activity 20.2 mc/mM) with a 37% yield (specific activity after dilution: 8.64 mc/mM). Four labelled insecticides were synthesized subsequently: aldrin-C^{14} (yield 82% relative to I), dieldrin-C^{14} (yield 79%); chlordane-C^{14} (92% yield) (II), heptachlor-C^{14} (yield 78% relative to II), α-chlordane-C^{14} (yield 21.4% relative to II). Biochemical studies were carried out with α-chlordane-C^{14} and heptachlor-C^{14} on Aëdes aegypti, the first giving a metabolite C, the second metabolites A (probably heptachlorepoxide) and B. In experiments on white rats, 55% of the insecticides could be isolated in the organs and excrements within 48 h of intravenous or intraperitoneal injection. The insecticides were not stored in the organs, most of the activity being eliminated in the faeces. The main turnover probably takes place in the liver. Results from in vitro experiments are very different from those obtained under physiological conditions. Human stomach secretions and rat bile did not affect the insecticides in vitro, at body temperature. Various fungi appear to be completely insensitive to the insecticides. The R_f values for the metabolites A, B, and C in the solutions employed agree for rats, fungi, mosquito larvae and liver homogenates.

530 Thomas, D.J., Kilner, A.E. THE SYNTHESIS OF THE INSECTICIDES ALDRIN AND DIELDRIN LABELLED WITH CARBON-14 AT HIGH SPECIFIC ACTIVITY. p.83-90 in "Proceedings of a Conference on Radioisotopes in the Physical Sciences and Industry, held in Copenhagen, 6-17 September 1960, Vol.III". Vienna, International Atomic Energy Agency. 1962.

Acetylene-1,2-C^{14} is converted successively to tetrachloroethane and trichloroethylene, and this is condensed with CCl_4 by the Prins reaction in the presence of aluminium chloride to octachlorocyclopentene. Dechlorination gives hexachlorocyclopentadiene which undergoes a Diels-Alder addition to bicyclo(2,2,1) hepta-2,5-diene to give aldrin-C^{14} in 12% yield from barium carbonate. Oxidation of aldrin gives the 6,7 epoxide, dieldrin, in 87% yield. The paper includes an account of the separation of octachlorocyclopentene from the crude product of the Prins reaction by gas-liquid chromatography and of the separation of aldrin and dieldrin on a small preparative scale by reversed-phase paper chromatography. (From auth.)

II-C-c CYCLODIENE

531 Brooks, G.T., Harrison, A. RELATIONS BETWEEN STRUCTURE, METABOLISM AND TOXICITY OF THE 'CYCLODIENE' INSECTICIDES. Nature 198, 4886 (1963) 1169-71.

A detailed examination of a number of derivatives of 1,2,3,4,7,7-hexachlorobicyclo[2.2.1]hept-2-ene and related compounds was undetaken to elucidate the marked differences in toxicity to adults of Musca domestica L. that exist between closely related compounds of this type and to provide a rational basis for the development of new ones. It would appear that detoxification processes are at least partly responsible for the differences in toxicity to M. domestica between several closely related substances incorporating the hexachlorobicycloheptane nucleus, though other factors may be involved. The greater toxicity of dieldrin and endrin as compared with their precursors (aldrin and isodrin) may be partly due to conversion of a carrier group (the bicycloheptane) of low efficiency to one that is more effective (the epoxybicycloheptane nucleus). The dihydro derivatives of aldrin and isodrin were stabilized by sesamex, and investigations with the compounds labelled with C^{14} confirmed the existence of detoxification mechanism inhibited by sesamex. The oxabicycloheptane system appears to be potentially as effective as the epoxybicycloheptane nucleus as a carrier group. Although an increase in polarity equivalent to that produced by epoxidation increased the toxicity of a molecule of the type of the dihydro derivative of isodrin, the increase in toxicity was not of the expected order. However, the toxicity of this compound appears to be potentially higher than was observed as it is synergized by sesamex, and is metabolized by M. domestica.

II-C-d BHC

532 Atalla, L.T., Lima, F.W. DETERMINATION OF THE γ-ISOMER OF HEXACHLOROCYCLOHEXANE BY ISOTOPE DILUTION. Inst. Energia At., Brazil 59 (1963) 14p. (In English).

The isotope-dilution method, associated with chromatographic separation, was applied to analysis of the γ-isomer of hexachlorocyclohexane. The labelled isomer is prepared by treating benzene with gaseous Cl labelled with Cl^{36}. Precision of the method is good, having a standard deviation of $< 0.1\%$ for samples with $\sim 10\%$ γ-isomer. (CA 60: 1964, 11311b)

533* Elias, H., Lieser, K.H., Kohlschütter, H.W. RADIOCHEMICAL INVESTIGATION OF THE ISOMERIZATION OF 1,2,3,4,5,6-HEXACHLOROCYCLOHEXANE. Chem. Ber. 93 (1960) 2128-37.

The isomerization of γ-(I) and α-1,2,3,4,5,6-hexachlorocyclohexane (II) in the homogeneous system hexachlorocyclohexane-$AlCl_3$-$(CHCl_2)_2$ was studied quantitatively at 100-30° as a function of time with I-C^{14} and II-C^{14}. I-C^{14} (0.14 mg) and 2.6 ± 0.2 mg $AlCl_3/cm^3(CHCl_2)_2$ was heated at various temperatures for certain periods of time, the cooled mixture shaken twice with 10-cm^3 portions 2 N HNO_3 and evaporated, and the residue analyzed by radio-paper chromatogram; the reaction time in h, and the % α-, β-, γ-, and δ-hexachlorocyclohexane in the mixture were given for the runs at the following temperatures: 99.4 ± 0.1°, 4,-, 7.9, 61.9, 30.2; 9, 8.5,-, 40.6, 50.9; 18, 9.4, 5.4, 29.9, 55.3; 50, 25.6, 4.1, 15.6, 54.7; 114.4 ± 0.1°, 4, 15.9, 2.6, 37.4, 44.1; 7.5, 10.7, 5.9, 22.5, 60.9; 12, 27.4,-, 12.1, 60.5; 20, 9.9, 5.5, 12.5, 72.1; 128.5 ± 0.1°, 1, 10.5,-, 44.2, 45.3; 2, 18.3,-, 28.7, 53.0; 5, 26.4, 3.9, 11.0, 58.7; 10, 34.1, 3.2, 8.8, 53.9. A series of similar runs was performed with 0.14 mg II-C^{14} and 2.6 ± 0.1 mg $AlCl_3/cm^3(CHCl_2)_2$ at the following temperatures (reaction time in h, and % α-, β-, and δ-hexachlorocyclohexane in the reaction mixture given): 99.4 ± 0.1°, 24, 93.2, 6.8,-; 64, 95.3, 3.3, 1.4; 90, 97.1, 2.0, 0.9; 114.4 ± 0.1°, 3, 95.7, 4.3,-; 15.5, 88.4, 8.3, 3.2; 28, 94.0, 4.2, 1.9; 40. 94.6, 3.2, 2.1; 128.5 ± 0.1°, 2, 90.2, 7.9, 1.9; 5, 92.6, 5.6, 1.8; 12.5, 91.5, 4.8, 3.6; 21, 85.6, 7.9, 6.5. The evaluation of these results showed that the isomerization proceeded by equilibrium, reactions according to the scheme: $\gamma\text{-} \rightleftarrows \delta\text{-} \rightleftarrows \alpha$-isomer. In the temperature region 100-30°, this equilibrium was shifted in favor of the α-isomer. Assuming bimolecular reactions of 2nd order, the rate constants and activation energies of the partial steps of the isomerization were calculated. (CA 55: 1961, 2514f)

534 Fukami, J., Nakatsugawa, T., Ishii, S. PENETRATION OF BHC ISOMERS THROUGH CUTICLE OF THE AMERICAN COCKROACHES. Jap. J. appl. Ent. Zool. 5 (1961) 281-2.

The penetration of α-, β- and γ-isomers of BHC through the insect cuticle has been studied in order to find why only the γ-isomer has a high insecticidal potency. BHC-1-C^{14} isomers were applied topically to Periplaneta americana, and the rate of penetration measured 1.5, 6 and 24 h after treatment. The γ-isomer penetrates more easily than the other isomers, (α-penetrating more quickly than β-BHC). The rates of penetration alone cannot, however, account for the differential toxic potency observed.

535* Ishii, S., Tamaki, Y., Hirano, C. SYNTHESIS OF BHC-1-C^{14} AND SEPARATION OF ITS ISOMERS. MODE OF ACTION OF BHC. I. Botyu-Kagaku 24, 4 (1959) 181-4. (In Japanese, with English summary).

Radioactive BHC was synthesized from C^{14}-labelled benzene; 0.4 mc of benzene-1-C^{14} (0.1 mc/1.32 mg) was diluted to 270 mg with unlabelled carrier benzene and made to react with Cl_2 absorbed in CCl_4 for 29 h under fluorescent light, as described. Crude BHC-1-C^{14} (950 mg) was obtained. Partition chromatography using silica gel and n-hexane saturated with nitromethane was employed for isomer separation. After recrystallization, α-BHC-1-C^{14} 470 mg, β-BHC-1-C^{14} 50 mg, γ-BHC-1-C^{14} 80 mg and δ-BHC-1-C^{14} 50mg were obtained. Radioactive α, β, γ-BHC isomers were confirmed to be chemically pure from autoradiograms of Mitchell's paper chromatographic technique. The wet combustion method using Van Slyke-Folch mixture could not be used for determining γ-BHC-1-C^{14} radioactivity because of sublimation. The specific activity of γ-BHC-1-C^{14} was calculated as 0.389 µc/mg from that of benzene-1-C^{14}. The measured value was in relatively close agreement. (From summary)

536* Ishii, S., Sekiguchi, K., Enjoji, S. SYSTEMIC NATURE OF γ-BHC IN PLANTS. MODE OF ACTION OF BHC. II. Botyu-Kagaku 24, 4 (1959) 184-88. (In Japanese, with English summary).

Radioactive γ-BHC emulsion, consisting of γ-BHC-1-C^{14} (0.398 µc/mg), xylene, triton X-100, and water, was prepared to study systemic action in plants. Experiments were carried out in which the emulsion was sprayed, dropped or used for immersing roots or leaves of the rice plant. From the results obtained it appeared that γ-BHC does not easily penetrate the plant cuticle nor translocate within the plant tissues, at any rate with the specific activity used. The results thus do not agree with studies carried out elsewhere where systemic action of γ-BHC was demonstrated by bioassay.

537* Ishii, S., Matsuda, A. EFFECT OF CHLORINATED TERPHENYL ON EVAPORATION OF γ-BHC. MODE OF ACTION OF BHC. III. Botyu-Kagaku 24, 4 (1959) 188-91. (In Japanese, with English summary).

Chlorinated terphenyls are known to inhibit evaporation of BHC from a surface. Chlorinated terphenyl (Aroclor 5460) was added to γ-BHC-1-C^{14} emulsion to test for changes in residual action of γ-BHC. Radioactive γ-BHC emulsion with or without chlorinated terphenyl was dropped on a glass plate and a rice plant leaf. Subsequent radioactivity was measured daily, and the results tabulated. No detectable residual activity remained on the leaf. Addition of chlorinated terphenyl to BHC emulsion is considered of practical value only for the control of domestic insects and insects in animal sheds.

538 Koransky, W., Portig, J. DER STOFFWECHSEL DER HEXACHLORCYCLOHEXAN-ISOMEREN UND SEINE BEEINFLUSSUNG DURCH MIKROSOMENAKTIVIERENDE PHARMAKA. (The metabolism of hechlorocyclohexane isomers and the effect of microsome-activating drugs). Arch. exp. Path. Pharmak. 243, 4 (1962) 294-5. (In German).

Following the administration of Cl^{36}-labelled BHC, the metabolites contained in the urine and stool of the animals were isolated and partially identified. α-isomer administration produced 4 fractions in the stool, one of which proved to be the unchanged isomer. Organically bound chlorine occurred mostly as 2,4,6-trichlorophenol. The oxidizing microsome enzymes of the liver probably played a part in this transformation. A single pre-treatment with α-BHC causes a marked reduction for about 30 d in the effect of Evipan and Eunarcon. It is therefore possible that the anticonvulsive effect of BHC with some poisons is partially due to accelerated detoxication reactions.

539 Kulikova, M.N., Strongin, G.M., Prokhorova, M.I. DETERMINATION OF δ-HEXACHLOROCYCLOHEXANE BY THE METHOD OF ISOTOPE DILUTION. Trud. Khim. Tekhnol. 1 (1963) 56-60. (In Russian).

A mixture of hexachlorocyclohexane isomers was extracted with enough isooctane to dissolve all δ-isomer (solubility at 20°, 1.6 g/100 g isooctane), which was then separated in 80-94% yield by partition chromatography on SiO_2 gel moistened with $MeNO_2$. In an accelerated procedure, 5 g SiO_2 gel, 2.8 ml $MeNO_2$, and 12 ml isooctane were charged into a column 300-350 mm long and 14 mm in diameter. The isooctane extract containing the δ-isomer was added, and elution with isooctane was carried out. The δ-isomer (15-20 mg) was eluted after the α- and γ-isomers. It was recrystallized from CCl_4-isooctane (yield 50%). The optimum amount of δ-isomer in the sample was 90-160 mg. As a tracer δ-isomer with an activity of 1000 impulses/min/mg was added at a ratio of 1:3 with reference to inactive δ-isomer. On artificial mixtures of α, β, γ, δ-isomers the limit of error was 2.3%. (CA 60: 1964, 16440b)

540 Portig, J., Koransky, W. RESORPTION, VERTEILUNG UND AUSSCHEIDUNG DER HEXACHLORCYCLOHEXAN-ISOMEREN IN BEZIEHUNG ZU IHRER KRAMPFHEMMENDEN WIRKUNG. (Absorption, distribution and excretion of hexachlorocyclohexane isomers in relation to their anticonvulsive effect). In: 3rd Spring meeting of the German Pharmacological Association, 1962. Arch. exp. Path. Pharmak. 243, 4 (1962) 293-4. (In German).

The metabolism and elimination of the α- and γ-isomers of BHC were investigated by means of C^{14}- and Cl^{36}-labelled compounds. Following subcutaneous and intraperitoneal application the material was rapidly distributed throughout the whole organism. High radioactivity was detected (autoradiographically) in the fatty tissue and certain well defined areas of the central nervous system. Consistent quantitative data were obtained when measurements were interpreted in terms of the lipoid content of the organ rather than wet weight. A consistent distribution of the organic lipoids was maintained even with progressive elimination. The radioactive substances contained were isolated and identified. Besides inorganic chlorine and traces of organic chlorinated compounds only unchanged BHC was found. Elimination of radioactivity in the stool and urine commences in the first few hours following application and continues for several weeks. The γ-isomer is eliminated at twice the rate of the α-isomer.

541 Torii, T. GIRDLING EXPERIMENTS ON THE TRANSLOCATION OF TOPICALLY APPLIED RADIOACTIVE γ-BENZENE HEXACHLORIDE-C^{14} IN CERTAIN WOODY PLANT WITH INSECT GALLS. Shinshu Daigaku Nogakubu Kiyo 2, 4 (1961) 355-75.

γ-Benzene hexachloride-C^{14} (I) was applied topically to leaf, flush terminal shoot, stem, and galls located above or below the girdled portion, and its penetration and translocation in the plant tissues was traced by autoradiography. Applied I was absorbed and translocated to several other tissues, acropetally as well as basipetally, and was especially accumulated in flush terminal shoots and galls where growth is active. Phloem is solely responsible for its translocation. The role of I in control of chestnut gall wasp was discussed. (CA 59: 1963, 15874g)

II-C-e CHLORFENSON

542* Tomizwa, C. FATE OF S^{35}-LABELED p-CHLOROPHENYL p-CHLOROBENZENESULFONATE IN SOME ORGANISMS. Botyu-Kagaku 25, 2 (1960) 47-51.

The investigations described showed that chlorfenson labelled with S^{35} was hardly at all decomposed in the eggs or adults of Panonychus (Metatetranychus) citri (McG) (the only stages of that mite tested), but was decomposed progressively in the abdomen, mid-gut and excreta of Periplaneta americana (L.), to which it was not toxic, the production of p-chlorobenzenesulphonic acid increasing in the same order. The product penetrated into Citrus saplings and soybean plants and was translocated. (RAE-A 52: 1964, 48)

II-C-f DDT

543 Acree, F., Jr., Beroza, M., Bowman, M.C. CODISTILLATION OF DDT WITH WATER. J. agric. Food Chem. 11, 4 (1963) 278-80.

The co-distillation rate of DDT with water from a placid surface in μg of DDT/g of water concentration from 1 to at least 100 ppb (100.10^{-9}) at 25°, 30°, and 35°C. At the highest concentrations tested in this study, the co-distillation rate was as much as 6 times greater than that which would be anticipated on the basis of the Rassow-Schultzky equation. This finding is in line with DDT's great affinity for the air-water interface which facilitates the high co-distillation rate. The significance of these results as related to the practical use of DDT is discussed. C^{14}-labelled DDT was used. (Essentially auth.)

544 Menzel, D.B., Miskus, R., Smith, S.M., Hoskins, W.M. THE METABOLISM OF C^{14}-LABELED DDT IN THE LARVAE, PUPAE, AND ADULTS OF Drosophila melanogaster. J. econ. Ent. 54, 1 (1961) 9-12.

A metabolic product of C^{14}-DDT in D. melanogaster Meigen was found to be primarily 2,2,2-trichloro-1,1-bis-(p-chlorophenyl) ethanol, (Kelthane®), confirming the results of Tsukamoto. Kelthane was found in larvae, pupae and adults exposed to larval medium containing C^{14}-DDT and also in adults exposed by topical application to C^{14}-DDT. Of the two strains of Drosophila examined by adult topical exposure, one (Oregon Rc) showed the active formation of Kelthane, while the other (Oregon R) did not. A new, unknown metabolite of the same chromatographic mobility as p,p'-dichlorobenzophenone was found in the larval exposure as well as a large amount of a very polar metabolite(s). Another new metabolite of the same chromatographic mobility as 2,2-dichloro-1,1-bis-(p-chlorophenyl) ethanol was found in the internal tissue extract upon adult topical exposure. (Auth.)

545* Rothe, C.F., Mattson, A.M., Nueslein, R.M., Hayes, W.J., Jr. METABOLISM OF CHLOROPHENOTHENE (DDT). A.M.A. Arch. industr. Hlth 16 (1957) 82-6.

Of the intestinally absorbed C^{14}-labelled DDT administered orally to rats with their thoracic lymph ducts cannulated, 47-65% was recovered in the chyle. Furthermore, 14-46% of the absorbed DDT-derived materials found in the chyle were dehydrohalogenated into a neutral material (DDE). (Auth. summary)

II-C-g PENTACHLOROPHENOL

546 Schmidt, L.H., Bubner, M. SYNTHESE VON PENTACHLORPHENOL-$^{36}Cl_{(5)}$. (The synthesis of pentachlorophenol labelled with Cl^{36} in Cl-5). Kernenergie 6, 2 (1963) 82. (In German).

This compound is used for wood protection against fungus and wood-boring insects. Synthesis is based on chlorination of the phenol and reduction of the Cl^{36}-labelled hexachlorophenol produced. It was carried out on a 100-mM-scale. Details of the procedure are given. A yield of 18 g (~68%, relative to phenol) was obtained; 160 μc of $NaCl^{36}$ were used, giving pentachlorophenol of a specific activity of 2 μc/g. Radiochemical yield was 22.5%, not allowing for recovered $NaCl^{36}$.

II-C-h TELODRIN

547 Stiasni, M. SYNTHESE VON TELODRIN-^{14}C UND DESSEN UMWANDLUNG DURCH MIKROORGANISMEN, MOSKITO-LARVEN UND RATTEN. (Synthesis of Telodrin-C^{14} and its transformation by microorganisms, mosquito larvae and rats). Thesis. Bonn. Universität. Organisch-Chemisches Institut. 1962. 68p. (In German).

A method for the microsynthesis of Telodrin (C^{14}-labelled in the hexachlorocyclopentane ring) was developed. C^{14}-labelled hexachlorocyclopentadiene reacts with 2,5-dihydrofurane to give the Diels-Alder-adduct R 67 which, on chlorination, gives C^{14}-labelled Telodrin. A 59% yield, relative to the pentadiene, with a specific activity of 8.9 mc/mM, was obtained. The microsynthesis of Telodrin-1,3-C^{14} (with a yield of ~10% relative to $KC^{14}N$, and specific activity 16.5 mc/mM) was repeated. Both products were purified by column chromatography, giving a purity > 99%. The synthesis products were checked against controls by thin-layer and column-chromatography. Telodrin-C^{14} and Telodrin-1,3-C^{14} give the same hydrophilic metabolite A when broken down by 4 different micro-organisms. Mosquito larvae break down metabolite A to ~20% of metabolite B, which is even more hydrophilic and consists of at least 3 components (57% BI, 23% BII, and 20% BIII). The hydrolysis product of BII was identified as Lacton I. BII and BIII were shown to be hydrolysable and to give rise to less hydrophilic compounds. The hydrolysis products of BI and BIII react with diazomethane to form less hydrophilic products. Stomach secretions in vitro do not affect Telodrin. The distribution of Telodrin-C^{14} in the organs and excrements of rats, following intravenous injection, was measured, and a metabolite of Telodrin was demonstrated in bile secretion. Only ~5% of the intravenously injected activity were eliminated in the course of 10 h.

II-C-j THIODAN

548 Gösswald, K. BEITRAG ZUR WIRKUNGSWEISE DES INSEKTIZIDE THIODANS®. (Further investigations into the mechanism of action of the insecticide Thiodan®). p.605-10 in "XI. Internationaler Kongress für Entomologie, Wien, 17 bis 25 August 1960. Verhandlungen. Band II (Symposien)". Wien, Organisationskomitee des XI. Internationalen Kongresses für Entomologie, Wien 1962. (In German).

Part of the paper is devoted to experiments with S^{35}-labelled Thiodan, an insecticide developed by Farbwerke Hoechst A.G. Its high vapour pressure allows application in the vapour phase which avoids possible contamination by direct contact. Experimental details are given. The uptake of the poison (not to be confused with its activity) is found to increase with increasing temperature and humidity. The technical product consists of 2 isomers with different melting points and different velocities of insecticidal effect. Experiments were continued with labelled α- and β-isomers and a (technical) mixture of equal specific activity. The α-isomer, with a higher vapour pressure than the β-, is taken up most rapidly and in the greatest quantity. The β-isomer appears to be specifically less effective. The lowest values were obtained for the mixture; it is therefore essential to repeat this work. Activity measurements carried out on dead and live insects showed that, for a limited period, the uptake of insecticide by the dead insects was greater than by the live ones. It is assumed that the soft radiation from S^{35} is primarily picked up from insecticide on the cuticle (the total activity requires wet-ash measurements). The development of higher temperatures inside the insect might lead to partial sublimation at the start due to metabolic processes. The temperature drops later. An insect which is still breathing may be assumed to breathe in an increased amount of insecticide, and dissolve it in the cuticular lipoids. Values obtained for radioactivity may be affected by a number of factors which must be taken into account in interpreting measurements.

549 Gösswald, K., Schulze, E.F., Kloft, W. PROBLEMS OF APPLICATION AND ACTION OF THIODAN STUDIED WITH S^{35}-LABELLED INSECTICIDE. p.241-7 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Using highly purified α- and β-isomers together with technical product, all labelled with S^{35} of the same specific activity (20 mc/g), problems of the application and mode of action of the isomers were studied. Since the insecticide can be experimentally applied in the vapour phase, the effect of different temperatures and air humidities on sublimation, and on penetration through the cuticula were tested. As intoxication began, a reactive increase in respiration, followed by a marked elevation of the insects' body temperature, were found. It was shown with labelled insecticides that this raising of body temperature after some time causes surface removal of the sublimated insecticidal substance by way of resublimation into the air. This mechanisms influences the complex mechanism of penetration, intoxication and detoxication in connection with temperature and relative humidity of the air. The main experiments were done with the granary weevil, *Calandra granaria*. Further experiments are concerned with the penetration and distribution of the labelled insecticide in the insect organism. (From auth.)

See also:

207 A new DDT-metabolizing enzyme in the German cockroach. (Agosin *et al.*, 1961)
380 Lipids of DDT-resistant and susceptible larvae of *Aedes aegypti*. (Fast and Brown, 1962)
620 Metabolism and toxicity of the "Cyclodiene" insecticides. (Brooks and Harrison, 1963)
621 Fate of aldrin and dieldrin in locusts. (Cohen and Smith, 1961)
623 Absorption and metabolism of C^{14}-labelled DDT by DDT-susceptible and DDT-resistant pink bollworm adults. (Bull and Adkisson, 1963)
624 Density-mortality relations in mosquito bioassay. (Cutkomp and Wattal, 1963)
625 The metabolic fate of DDT-C^{14} in *Triatoma infestans*. (Dinamarca *et al.*, 1962)
626 Factors involved in differential susceptibility of corn earworm larvae to DDT. (Gast, 1961)
627 Metabolism of dichlorodiphenyltrichloroethane in the German roach. (Hoskins *et al.*, 1960)
628 Fate of DDT and toxaphene applied topically to susceptible and resistant boll weevils. (Lindquist *et al.*, 1961)
629 The enzymatic *in vitro* degradation of DDT by susceptible and DDT-resistant body lice. (Perry *et al.*, 1963)
634 Insecticides in metabolism. IV. Iridomyrmecin-(3-C^{14}). (Korte and Schreiber, 1962)
640 Biochemical study of a malathion-tolerant strain of *Aedes aegypti*. (Matsumura and Brown, 1961)
647 Final report on an investigation into the metabolism of insecticide R 6700, patent applied for, carried out for the firm Ruhrchemie AG., Oberhausen-Holten, by means of radioisotopes. (Becker *et al.*, 1956)
653 Uptake of Telodrin by fall armyworm larvae exposed to residues. (Cox and Bowman, 1963)
654 Metabolism of aldrin and dieldrin by the American cockroach, *Periplaneta americana* (L.). (Hamilton, 1961)
655 Insecticides in metabolism. III. Microsynthesis of C^{14}-labelled Telodrin. (Korte and Stiasni, 1962)
658 Use of radioisotopes in studying the absorption, distribution and elimination of certain insecticides in animals. (Filatov *et al.*, 1963)
660 Studies on the metabolism of aldrin-C^{14} in rats and rabbits. [Isolation of metabolities]. (Kochen, 1963)
664 Absorption, distribution, and elimination of α- and γ-benzene hexachloride. (Koransky *et al.*, 1963)
667 A study of the absorption of ^{14}C-labelled DDT from water by fish. (Holden, 1962)
668 Uptake and detoxification of C^{14}-labeled DDT in Atlantic salmon. (Premdas and Anderson, 1963)
698 Translocation of γ-BHC in rice plant cultured in aqueous solution of C^{14}-γ-BHC. (Ishii and Hirano, 1962)
705 Factors contribution to the loss of insecticide deposits on cattle. (Roberts and Chamberlain, 1963)
706 Determination of residues of toxic principles in milk and meat by the use of radioactive indicators. (Kartashova and Kartashov, 1961)
708 *In vitro* stability and recovery of insecticides from milk. (Timmerman *et al.*, 1961)
709 Insecticide residues. Procedure for cleanup of butterfat prior to analyses for dieldrin residues. (McKinley and Savary, 1962)
720 The application and measurement of labelled residual insecticides in some physico-chemical studies. (Phillips, 1963)
731 Extraction procedures for chloro-organic insecticides. (Klein *et al.*, 1959)
733 Investigation into the problem of insecticide sorption by soils. (Gerolt, 1961)
734 Loss of parathion and DDT to soil from aqueous/dispersions and vermiculite granules. (Weidhaas *et al.*, 1961)
1547 An isotope dilution technique was used to determine the γ-HCH content in commercial mixtures. (Sieber and Jumar, 1962)
1555 Some applications of radioisotopes to the study of the contamination of insects by insecticide solutions. (Lewis, 1963)

II-D Organophosphates

II-D-a GENERAL

550 Heath, D.F. ORGANOPHOSPHORUS POISONS. ANTICHOLINESTERASES AND RELATED COMPOUNDS. London, Pergamon Press. 1961. 403p.

Emphasis is given to fundamental aspects rather than to results of applied research (except when fundamental). The book is divided into 4 parts dealing with chemistry, biochemistry, pharmacology in mammals, and pharmacology in insects. Numerous studies in which use has been made of radioisotopes are quoted in the text.

II-D-b BAYCID

551 Fukuda, H., Masuda, T., Miyahara, Y., Tomizawa, C. FATE OF *O,O*-DIMETHYL *O*-(3-METHYLMERCAPTOPHENYL) THIOPHOSPHATE SPRAYED ON RICE PLANTS. *Jap. J. appl. Ent. Zool.* *6*, 3 (1962) 230-6. (In English).

Three kinds of rice plant (two varieties: Norin No.18 and Gaisenmochi) were used and sprayed with the (P^{32}-labelled) insecticide, Baycid. The hydrolysis rate of Baycid appeared to be less than that of methyl parathion or of malathion. Only 10% of chloroform-extractable metabolites remained after 6 h. Such metabolites consisted mostly of PS-sulfoxides and PS-sulfones, with scarcely any oxidation products in the PO-form. When Baycid was sprayed a few days before heading, the metabolites tended to accumulate in the ears and grain (7 ppm "Baycid" were detected in rice grains, 29 d after application). The metabolites in the grains were concentrated in bran not in polished rice or the husk. The water-extractable metabolites in the rice grains 14 d after application were separated by ion exchange chromatography, and the existence of phosphoric acid, *O,O*-dimethyl phosphoric acid, *O,O*-dimethyl thiophosphoric acid, *O*-methyl *O*-(3-methyl-4-methylmercaptophenyl) thiophosphoric acid and an unknown metabolite were found. The proportion of a monodemethylated compound in Baycid was unexpectedly high.

II-D-c BAYER S 4741

552 Tomizawa, C. RESIDUAL BEHAVIOUR OF *O,O*-DIMETHYL *S*-ISOPROPYL-2-SULFINYLETHYL PHOSPHOROTHIOLATE AND ITS ANALOGUES IN PLANTS. *Jap. J. appl. Ent. Zool.* *7*, 2 (1963) 140-9. (In English).

This main constituent of the systemic (anti-mite- and aphid-) insecticide known as Bayer S 4741 was labelled with P^{32}. The degradation rate (examined by chloroform-water partition coefficient of radioactive material) in citrus leaves was the same for spray and topical application. In orange fruit, the residue (on 8th day post-application) in the peel was greater than in the juice. Residues and penetration are discussed for apple trees, radish, and sugar beet. After penetration of the insecticide into plant tissues, the mercaptosulfur moiety of the insecticide molecule was oxidized to produce the sulfone as in Systox. Phosphoric acid and dimethyl phosphoric acid were found as the hydrolysis products of the insecticide by ion exchange chromatography, and the production ratio of these metabolites was different among the test plants.

II-D-d BAYTEX

553 Shoffeitt, P.E. COMPARATIVE STUDIES WITH CERTAIN ANTIDOTES FOR ORGANOPHOSPHATE POISONING. *Diss. Abstr.* *23*, 9 (1963) 3565-6.

One part of the work deals with the effect of SKF 525A (beta-diethylaminoethyl diphenylpropylacetate) on the metabolism of Baytex (*O,O*-dimethyl *O*-[4-(methylthio)-*m*-tolyl]phosphorothioate) by the white rat and the American cockroach, *Periplaneta americana* L., as investigated by means of P^{32}, column chromatography, infrared analyses, and cholinesterase assays. Baytex elimination from rats (urine, faeces) is discussed. Metabolites formed by phosphoryl sulfur and thiphenyl sulfur oxidation of Baytex by rats included the oxygen analogue, the sulfoxide and sulfone of the parent compound, the oxygen analogue sulfoxide, and the oxygen analogue sulfone. These oxidation products were isolated by selective solvent extraction, separated and characterized. The hydrolysis products of Baytex were dimethyl phosphorothioic acid, and dimethyl phosphoric acid. Two hydrolysis products were not characterized. An increase in Baytex hydrolysis was observed in cockroaches pre-treated with SKF 525A, as compared with controls. SKF 525A did not, however, inhibit the oxidation of Baytex.

II-D-e BIDRIN

554 Menzer, R.E. METABOLISM OF RADIOLABELED 3-(DIMETHOXYPHOSPHINYLOXY)-N,N-DIMETHYL-cis-CROTONAMIDE (BIDRIN, SD 3562) IN BEANS AND MAMMALS. (Abstr. 51). Bull. ent. Soc. Amer. 9, 3 (1963) 163.

The in vivo metabolism of P^{32} and N-methyl-C^{14}-labelled Bidrin was studied. The main metabolite of toxicological interest in both plants and mammals was the des-N-methyl derivative of Bidrin which is of comparable toxicity to the parent compound. The fate of other fragments from the molecule will also be discussed.

II-D-f DEMETON

555 Groves, K., Haguwitz, R. PREPARATION OF LABELED 2-ETHYLTHIOETHANOL, A DEMETON INTERMEDIATE. J. agric. Food Chem. 9, 4 (1961) 262-3.

A small-scale synthesis of 2-ethylthioethanol by the catalytic condensation of ethylene oxide and ethyl mercapton is described. A S^{35} or C^{14} label may be incorporated in the alcohol, which is an intermediate in the preparation of demeton (O,O-diethyl O-ethylmercaptoethyl phosphorothioate). (From auth.)

II-D-g DIMETHOATE

556 Brady, U.E., Jr., Arthur, B.W. BIOLOGICAL AND CHEMICAL PROPERTIES OF DIMETHOATE AND RELATED DERIVATIVES. J. econ. Ent. 56, 4 (1963) 477-82.

Seventeen dimethoate derivatives were prepared in the laboratory, purified, and characterized. Derivatives containing dimethoxy groups were more effective against the house fly, Musca domestica L., than the diethoxy compounds. As the N-carbamoyl chain length increased in number of carbon atoms, the toxicity to house flies decreased; the monoalkyl-substituted amides were more effective than the dialkyl-substituted amides. Increase in chain length of the dialkoxy or N-carbamoyl groups resulted in increased stability to alkaline hydrolysis. The most toxic materials to the house fly were those having the C=O band between 5.90 and 5.95 μ. The absorption, distribution, metabolism, and excretion of P^{32}-labelled dimethoate were studied in rats and 3 species of insects (M. domestica L. Blatella germanica (L.), and Periplaneta americana (L.). Phosphorothioate oxidation was prevalent in rats, but the degrading rather than activating systems were predominant. Amidase activity was more pronounced in rats than in insects immediately following treatment with dimethoate; this major metabolic difference may partially explain selectivity. Phosphatase activity was also more evident in rats than in insects. (From auth.)

557 Casida, J.E., Sanderson, D.M. REACTION OF CERTAIN PHOSPHOROTHIONATE INSECTICIDES WITH ALCOHOLS AND POTENTIATION BY BREAKDOWN PRODUCTS. J. agric. Food Chem. 11, 1 (1963) 91-6.

Dimethoate* increases in toxicity to mammals on storage in certain hydroxylic solvents, particularly 2-alkoxyethanols. The reaction of dimethoate with 2-methoxyethanol at elevated temperatures yields at least 6 phosphorus-containing ionic products, 7 neutral phosphate esters other than the original compound, and the disulfide of N-methyl-mercaptoacetamide. P^{32}-labelled dimethoate was used (prepared, purified and characterized as described in J. agr. Food Chem. 7: 1959, 188). No evidence was obtained for the formation of stable pyrophosphates. The product of highest mammalian toxicity was a S-(N-methylcarbamoylmethyl) phosphorothiolate with one or both O-methyl groups replaced by O-(2-methoxyethyl) groupings. The toxicity to mammals of a few other phosphorothionate insecticides also increased on reaction with 2-methoxyethanol. Certain preparations of technical dimethoate contained an impurity, which somewhat increased the toxicity of dimethoate to several organisms, including the rate, following oral administration. Purified dimethoate reacted with lithium chloride or potassium O,O-dimethyl phosphorodithioate yielding a dimethoate potentiator, probably through O-demethylation as the initial reaction. (Mostly auth.)

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* O,O-dimethyl S-(N-methylcarbamoylmethyl) phosphorodithioate

558 Pietri-Tonelli, P. de, Barontini, A. COMPORTAMENTO DEL ROGOR-P^{32} APPLICATO SULLE PIANTE. I. PENETRAZIONE E TRASLOCASIONE DEL ROGOR-P^{32} APPLICATO SUL TRONCO DI PIANTE DI LIMONE. (Behaviour of P^{32}-labelled Rogor applied to plants [by spray treatment]. I. Penetration and translocation of Rogor P^{32} applied to the trunk of the lemon tree). Contr. Ist. Ric. agr., Soc. Montecatini 4 (1961) 39-52. (In Italian).

By means of radiological assays, bioassays and autoradiography it has been established that P^{32}-labelled Rogor, which is systemically effective against several species of pests feeding on the leaves, bark and fruits, when applied to the trunk or stem of lemon plants, is readily absorbed, transported mainly upwards and, together with its metabolites, translocated in high dosage into the branches and twigs, a very large amount into the leaves, in a smaller quantity into the flowers and fruits (more into the peel) and in a very low concentration into the roots. Only the initially formed xylem and the pith show no traces of P^{32}-containing substances since almost the entire amount (about 97%) of the applied insecticide leaves the treated area of the trunk and migrates into other organs. The upward movement occurs mainly through the xylem and less through the phloem in which, however, a relatively large amount of radioactive compounds accumulates by radial transfer from the xylem. The translocation into the roots takes place mostly through the phloem. (From auth. summary).

559 Pietri-Tonelli, P. de, Barontini, A. COMPORTAMENTO DEL ROGOR-P^{32} APPLICATO SULLE PIANTE. II. PENETRAZIONE E TRASLOCAZIONE DEL ROGOR-P^{32} APPLICATO SU PIANTE DI AGRUMI. (Behaviour of P^{32}-labelled Rogor applied to plants [by spray treatment] II. Penetration and translocation of P^{32}-labelled Rogor sprayed on crops.) Constr. Ist. Ric. agr., Soc. Montecatini 4 (1961) 53-64. (In Italian).

Further investigations were carried out on the distribution of the translocated material after the application of P^{32}-labelled Rogor (diluted with water to 0.05% - 0.1%) to the whole surface as well as only a part of the surface of leaves, fruits and twigs of citrus plants. There is evidence that, while the cell-to-cell movement into the tissues located just under the exterior parts which have been treated occurs over a very short distance but in relatively high concentration, the translocation through the vascular bundles occurs, on the contrary, over a great distance (mainly upwards and towards the growing organs) but, owing to the low dosage at which insecticide is applied, leads to relatively low concentrations of translocated material. (From auth. summary).

560 Pietri-Tonelli, P. de, Barontini, A. COMPORTAMENTO DEL ROGOR-P^{32} APPLICATO SULLE PIANTE. III. PENETRAZIONE E TRASLOCAZIONE DEL ROGOR-P^{32} APPLICATO PER IRRORAZIONE SU PIANTE ERBACEE ED ARBOREE. (Behaviour of P^{32}-labelled Rogor applied to plants [by spray treatment]. III. Penetration and translocation of P^{32}-labelled Rogor applied by spraying herbacious plants and trees). Italy. Istituto di Ricerche Agrarie. Laboratorio di Signa, Firenze. Montecatini, Società Generale per l'Industria Mineraria e Chimica - Milano, 1961. p.3-20. (In Italian, with English summary).

Autoradiographic and radiometric techniques were used for studying the distribution and translocation of Rogor in cotton and potato plants, fruit and leaves of olive trees, and fruit of peach sprayed with P^{32}-labelled Rogor. There is evidence that, following treatment, the insecticide and its metabolites occur in various concentrations throughout the various organs of the cotton plant, including the roots, and are concentrated in the bracteoles. These products also, systemically, reach the unsprayed bolls and leaves. (From auth. summary).

561 Pietri-Tonelli, P. de, Biondi, G., Barontini, A. ESPERIMENTI DI LOTTA CONTRO ALCUNE SPECIE DI COCCINIGLIE DEGLI AGRUMI. (Experiments on the control of some species of plant coccids). Italy. Istituto di Ricerche Agrarie. Laboratorio di Signa, Firenze. Montecatini, Società Generale per l'Industria Mineraria e Chimica - Milano. 1961. p.3-28. (In Italian, with English summary).

After a review of the means and methods, based on sprays with oils, organophosphorus compounds, and with oil-organophosphorus combinations which are more frequently recommended for the control of citrus scales, results are reported for laboratory investigations conducted to determine the activity of Rogor* (initial specific activity: 1.54 mc/mM) against some species of armoured and soft scales and mealybugs and to compare the effectiveness with that of parathion and other products. Data on field trials in citrus orchards infested by dicytospermum (Chrysomphalus dicytospermi Morg.), purple scale (Mytilococcus Beckii Newm.) and citrus mealybug (Pseudococcus citri Risso) are reported. Some work with P^{32}-labelled Rogor and autoradiography on the method of action of Rogor and parathion on C. dictyospermi indicated that penetration of parathion occurs through the rostralis, as a stomach poison, and through the "armour" or scale covering, as a contact poison. Rogor, on the other hand, does not reach the body of the insect through the scale covering but is absorbed as a stomach poison after its penetration and translocation, for a short distance, into the mesophyll of the leaf.

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* dimethoate [O,O-dimethyl S-(N-methylcarbamoylmethyl) phosphoradithioate

562 Pietri-Tonelli, P. de, Barontini, A., Biondi, G. SYSTEMIC MIGRATION AND INSECTICIDAL ACTIVITY OF DIMETHOATE APPLIED ON TREE TRUNKS. p.407-32 in "New Developments, Including New Compounds, Novel Formulations, or New Application Methods - Session VIII", Soc. Montecatini. Institute of Agricultural Research, Signa Laboratory, Insecticide Group. 1961.

By using P^{32}-labelled dimethoate (initial specific activity 1.43 mc/mM) the concentration of some the translocated substances and the distribution of labelled compounds could be determined in many cases by radioanalysis and autoradiography. The relation between effectiveness and phytotoxicity of dimethoate applied to lemon, orange, tangerine, olive, apple, pear, cherry and peach are summarized in a table (p.418). In peach, following trunk application, the concentration of P^{32} percent as dimethoate and its degradation products (total P^{32}), and the concentration of P^{32} which could be extracted by means of chloroform and is present as dimethoate and its P = O metabolite ($P^{32}/CHCl_3$) were determined. The concentration of both total P^{32} and $p^{32}/CHCl_3$ reaches and maintains higher levels in the leaves (greater in the terminal leaves) than in the fruit. The temporal pattern of distribution of P^{32} in leaves and in fruit (also sectioned) is discussed in some detail (p.420; figs. 6, 7, 8). The adverse effects of trunk application, and the influence of the formulation on the effects on pests and plants are discussed. Even the least damaging among the solvents tested evidently permits the transfer of P^{32}-labelled dimethoate and its metabolites from the trunk to the leaves. The seriousness of the effect appears positively related to the speed of translocation of the active ingredient and to its maximum concentration in the leaves.

563 Santi, R. PENETRAZIONE, TRANSLOCAZIONE E METABOLISMO DEL ROGOR-P^{32} APPLICATO SUL TRONCO DI PIANTE DI LIMONE. (Penetration, translocation and metabolism of P^{32}-labelled Rogor applied to the trunk of the lemon tree). Italy. Istituto di Ricerche Agrarie. Laboratorio di Signa, Firenze. Montecatini, Società Generale per l'Industria Mineraria e Chimica - Milano, 1961. p.3-19. (In Italian, with English summary).

It was shown by radiometric, paper-chromatographic and autoradiographic methods that P^{32}-labelled Rogor (together with tri-*n*-butylphosphate), when applied to lemon tree trunks, was quickly absorbed into the inner parts and translocated, mainly upwards. Metabolism of Rogor followed essentially 2 routes: an oxidative one with formation of its P = O derivative, S 31 (*N*-monomethylamide of *O*,*O*-dimethyl thiophosphoracetic acid), and a hydrolytic one bringing about the formation of several products (*O*,*O*-dimethylphosphorothioic acid and *O*-methyl *O*-hydrogen *S*-(*N*-methylcarbamoylmethyl) phosphorodithioate). Extremely high concentrations of Rogor were found in the leaves, moderately high ones in twigs and rather low ones in fruit. Concentrations were higher in the skin of the fruit than in the endocarp. Small quantities of P^{32}-containing substances, not chemically identified but not Rogor or S 31, were found in the roots. Hydrolytic breakdown products extracted from leaves and made up mostly of *O*-methyl *O*-hydrogen *S*-(*N*-methylcarbamoylmethyl) phosphorodithioate or of *O*,*O*-dimethylphosphorothioic acid, or both, can be absorbed by the root system of young lemon plants and translocated towards the epigeic organs. (From auth. summary).

564 Santi, R., Giacomelli, R. METABOLIC FATE OF P^{32}-LABELED DIMETHOATE IN OLIVE FRUITS AND SOME TOXICOLOGICAL IMPLICATIONS. *J. agric. Food Chem.* *10*, 3 (1962) 257-61.

Dimethoate was studied for use in the control of the olive fly, *Dacus oleae* (Gmel.), and proved to be both effective and safe. Metabolism of P^{32}-labelled dimethoate* in olives for eating and in olives yielding oil is very similar. In these fruits, dimethoate undergoes oxidation to the oxygen analogue (P=O derivative) [*O*,*O*-dimethyl *S*-methylcarbamoylmethyl phosphorothioate] and hydrolysis to degradation products such as phosphoric acid or methylphosphoric acid or both. When dimethoate is applied to olives for oil, according to the recommended schedule, the oil is practically free from toxic residues. When dimethoate is applied to eating olives, the usual industrial process with NaOH produces further degradation and a strong extraction of the P-containing insecticidal residues. (Essentially auth.)

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* *O*,*O*-dimethyl *S*-(*N*-methylcarbamoylmethyl) phosphorodithioate.

565 Santi, R., Radice, M., Giacomelli, R., Bazzi, B. STUDIO SUL METABILISMO DEL ROGOR-P^{32} NELLE BIETOLE DA ZUCCHERO E DA FORAGGIO. (Study on the metabolism of P^{32}-labelled Rogor in sugar and fodder beet). Italy. Istituto di Ricerche Agrarie. Montecatini, Società Generale per l'Industria Mineraria e Chimica - Milano. 1962. p.3-22. (In Italian, with English summary).

Metabolism in the leaves was carried out by means of P^{32}-labelled active principle. Metabolism was found to follow essentially an oxidative and a hydrolytic course, with the formation of the P = O derivative, and of phosphoric acid, *O*,*O*-dimethylphosphoric acid, *O*,*O*-dimethylphosphorothioic acid and *O*-methyl, *O*-hydrogen of *S*-(*N*-methylcarbamoylmethyl) phosphorothioate respectively. The presence of 4 other P^{32}-labelled substances of unknown composition was also noted. The concentration of Rogor and its metabolites, known and unknown, varied in tissue with the time interval between treatment and sampling. Even long after treatment, the *O*,*O*-dimethylphosphorothioic acid is the component with the highest concentration in the leaves. Of the total P^{32} sprayed, only a small percentage was discovered in the roots of the field-grown sugar beet. It is essentially localized in the vascular tissue, and can be attributed to an unknown metabolite and to traces of *O*,*O*-dimethylphosphoric acid. The threshold of toxicity of Rogor and its P=O derivative for *Aphis fabae* was between 0.2 and 0.3 ppm. These levels are still present 26 d after treatment. There is a considerable safety margin from the health point of view in using Rogor as described. (From auth. summary).

566 Santi, R. PENETRATION, TRANSLATION, AND METABOLISM OF ROGOR-^{32}P APPLIED ON LEMON TREE TRUNKS. *Contr. Ist. Ric. agr., Soc. Montecatini* *5* (1961) 47-63. (In Italian).

Autoradiography, paper chromatography, and radiometry showed that a formulation of Rogor-P^{32} (*I*) with Bu_3PO_4 was quickly absorbed and translated, mainly upwards, when applied on lemon tree trunks. Metabolism of *I* followed 2 routes: (1) oxidination with formation of its P:O derivative. (II); (2) hydrolysis giving *O*,*O*-di-Me phosphoric acid, *O*,*O*-di-Me phosphorothioic acid, *O*-Me *O*-H S-(*N*-methylcarbamoylmethyl) phosphorodithioate, and H_3PO_4. Concentrations of *I* were extremely high in leaves, moderately high in twigs, and rather low in fruits, being higher in the skin than in the endocarp. Presence of *I* and *II* in the roots had to be excluded. (CA 60: 1964, 7384h)

II-D-h ETHION

567 Forman, S.E., Gilbert, B.L. ETHION-P_2^{32}. *J. agric. Food Chem.* *9*, 4 (1961) 260-2.

The insecticide *O*,*O*,*O'*,*O'*-tetraethyl *S*,*S'*-methylene biphosphorodithioate-P_2^{32} (ethion-P_2^{32}) was prepared for use in biological studies. The product obtained from 3 c of $H_3P^{32}O_4$ contained 780 mc of P^{32} with a specific activity of 28.4 mc/g. When allowance is made for decay of the P^{32} (half-life 14.3 d), this quantity represents a radio-yield of 33%. Estimated vapour pressure of ethion was 1.5×10^{-6} mm at 25°C. (Auth.)

II-D-j FAMOPHOS

568 Sferra, P.R. METABOLISM OF FAMOPHOS IN MAMMALS AND INSECTS. (Abstr.49). *Bull. ent. Soc. Amer.* *8*, 3 (1962) 155.

The rates of hydrolysis of tritiated Famophos, dimethyl 4-(dimethylsulfamoyl) phenyl phosphorodithionate, by whole insects and mammals were examined, and the results correlated with toxicity.

II-D-k FENTHION

569 Metcalf, R.L., Fukuto, T.R., Winton, M.Y. CHEMICAL AND BIOLOGICAL BEHAVIOR OF FENTHION RESIDUES. *Bull. World Hlth Org.* *29*, 2 (1963) 219-26.

The activity of the insecticide fenthion, *O*,*O*-di-Me *O*-[4-(methylthio)-*m*-tolyl] phosphorothionate (I), was compared with those of its principal oxidation products. P^{32}-labelled *I* and its oxidation products were applied topically to 3 strains of houseflies and tested against larvae and adults of 2 species of mosquitoes. *I* and its products were separated by paper chromatography, using propylene glycol as the immobile phase on Whatman No.1; the mobile phase was hexane-toluene (7:3 vol/vol), saturated with the glycol. Spots were detected by spraying with 5% 2,4-dibromo-*N*-chloroquinone imine and heating, and by bioassay, using mosquito larvae, of 1-cm sections of the paper strips. Results indicate that the oxidation products are unstable in H_2O and that I is a weak in vitro inhibitor of cholinesterase. I was unstable when exposed to sunlight and air, yielding 11 compounds, most of which are H_2O-soluble. Heating at 140° in an atmosphere of N caused a rapid breakdown of I, yielding the S-Me isomer primarily. Metabolism studies, using cotton plants and adult female houseflies, demonstrated that I is readily oxidized, as a surface residue or in plant and animal tissues, to sulfoxide and sulfone derivatives. (CA 60: 1964, 3433b)

II-D-l LEBAYCID

570 Niessen, H., Tietz, H., Frehse, H. ÜBER DAS VORKOMMEN BIOLOGISCH AKTIVER UMWANDLUNGSPRODUKTE DES WIRKSTOFFS S 1752 BEI DER ANWENDUNG VON LEBAYCID. (On the occurrence of biologically active metabolites of the active ingredient S 1752 after application of Lebaycid®). Leverkusen, Höfchenbr. Bayer PflSchütz-Nachr. 15, 3 (1962) 129-51. (In German, with English summary).

The active ingredient is O,O-dimethyl-O-(3-methyl-4-methylmercaptophenyl-)thiophosphate (I). Following application of P^{32}-labelled Lebaycid (available at a specific activity of 3.4 mc/g) on plants (Phaseolus vulgaris), 4 oxidation products of S 1752, namely suphoxide (II) and sulphone (III) of S 1752 as well as sulphoxide (V) and sulphone (VI) of the oxygen-analogous phosphate form, were detected by paper chromatographic separation of purified plant extracts. By measuring the distribution of radioactivity on the paper chromatograms, it was possible to determine the 4 oxidation products quantitatively. The P^{32}-labelled active ingredient contained ~5% of S-methyl isomer VII. This compound is also oxidized to sulphoxide (VIII). Isomerization to S-methyl compounds in the plant was not observed, however. Immersion of the roots of young plants in Lebaycid emulsion and a study of the velocity of penetration after application on the leaf proved that the preparation has a slight systemic action. The quantitative study of the influence of light, plant enzymes and temperature on the transformation of S 1752 revealed that oxidation at the position of the methylmercapto group is chiefly due to the influence of light, while plant enzymes mainly oxidize the active ingredient at the position of the thiono-sulphur atom of phosphoric acid. Isomerization to S-methyl compounds takes place only at high temperatures.

II-D-m MALATHION

571 Giles, R.H., Jr., Peterle, T.J. DISTRIBUTION OF AERIALLY APPLIED MALATHION-S^{35} IN A FOREST ECOSYSTEM. p.55-83 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

A faunal survey of two 20-acre watersheds was conducted during the summer of 1961. In May of 1962, one of the watersheds was treated with an application of 2 lb technical-grade malathion per acre in a formulation of xylene, triton X-155 emulsifier and water. S^{35}-labelled malathion (specific activity 17.5 mc/mM) was applied aerially (1 c of activity) to one of the 20-acre forested areas. The distribution of components of the aerial spray within the forest was measured. Electrically-operated air samplers provided estimates of drift off the area; helium-filled balloons bearing frosted-glass discs measured above-canopy application; glass discs suspended vertically as well as bark samples measured quantities settling out at different layers in the canopy; glass discs and spotting-enamel paper not only allowed a measure of horizontal distribution but a check of a standard spray-distribution detection device. Soil samples and monitoring of marked stakes allowed sub-surface distribution studies. Samples of water from the intermittent streams, insects, mammals, reptiles and birds indicated the initial and subsequent distribution of the insecticide and its metabolites in the ecosystem. Population studies of the faunal system continued throughout the summers of 1961-62 and a limited amount of survey data will be collected in the summer of 1963. Preliminary results indicate that the insect populations returned to normal in about 3 weeks and there was no detectable effect on the densities of the vertebrate animals on the sprayed area. (From auth.)

II-D-n PARATHION AND METHYL PARATHION

572 O'Brien, R.D. THE EFFECT OF SKF 525A (2-DIETHYLAMINOETHYL 2:2-DIPHENYLVALERATE HYDROCHLORIDE) ON ORGANOPHOSPHATE METABOLISM IN INSECTS AND MAMMALS. Biochem. J. 79 (1961) 229-35.

SKF 525A (2-diethylaminoethyl 2:2-diphenylvalerate hydrochloride) protects mice against poisoning by the 3 phosphorodiamidic compounds tested. Of the 8 phosphorothionates tested, protection against dimethoate only was observed. With houseflies and American cockroaches, SKF 525A gave no protection against any phosphorothionates. SKF 525A inhibited the conversion of parathion into paraoxon by mouse-liver slices or cockroach guts. SKF 525A inhibited the 'activation' of schradan by cockroach guts, as had previously been shown for rat-liver preparations. With mice and cockroaches in vivo, SKF 525A increased the concentration of paraoxon caused by the injection of parathion, and reduced the degradation of injected paraoxon. It was concluded that the diverse effects of SKF 525A on organophosphate toxicity in various species were due to the variations in the importance of inhibition of 'activating' as opposed to degrading enzymes. P^{32}-labelled parathion (0.1% in propylene glycol was used in the study and injected into mice and Periplaneta americana, at 5 mg parathion/kg. Labelled Paraoxon was prepared by passing N_2O_4 for 5 min at room temperature through a solution of labelled parathion in 10 ml methylene chloride, as a first step.1 mg P^{32}-labelled paraoxon/kg was injected into the animals.

573 Knaak, J.B., Stahmann, M.A., Casida, J.E. PEROXIDASE AND ETHYLENEDIAMINETETRAACETIC ACID-FERROUS IRON-CATALYZED OXIDATION AND HYDROLYSIS OF PARATHION. J. agric. Food Chem. 10, 2 (1962) 154-8.

Peroxidase and the ethylenediaminetetraacetic acid-ferrous iron (EDTA-Fe^{+2}) complex were investigated for their ability to catalyze the oxidation and hydrolysis of parathion in the presence of an active hydrogen donor. Peroxidase catalyzed a 10% oxidation of parathion to para-oxon, while 12% conversion was maximum for the EDTA-Fe^{+2} complex. In addition to this oxidative conversion, peroxidase catalyzed the hydrolysis of 36% of the parathion and the EDTA-Fe^{+2} complex hydrolyzed 66%. Para-oxon was more stable than parathion to this hydrolytic attack. The EDTA-Fe^{+2} complex catalyzed 12% hydrolysis of para-oxon, whereas peroxidase catalyzed the hydrolysis of 6%. Peroxidases in plants may play a role in the metabolism of parathion and related phosphorothionates. P^{32}-labelled parathion and para-oxon were used. (From auth.)

574* Saito, T., Tomizawa, C. CERTAIN PROPERTIES OF METHYL PARATHION (EVAPORATION AND DEGRADATION OF MINUTE AMOUNTS AND CHANGES WHEN STORED IN DUSTS) EXAMINED BY TRACER TECHNIQUE. Botyu-Kagaku 25, 3 (1960) 85-90.

II-D-o PHOSPHAMIDON

575 Anliker, R., Beriger, E., Schmid, K. DIE SYNTHESE VON ^{14}C-MARKIERTEM PHOSPHAMIDON, EINEM NEUEN SYSTEMISCHEN INSEKTIZID. (The synthesis of C^{14}-labelled phosphamidon, a new systemic insecticide). Experientia 17, 11 (1961) 492-3. (In German).

Starting with C^{14}-labelled barium carbonate, phosphamidon III (O,O-dimethyl-O-[2-chloro-2-diethylcarbamoyl-1-methylvinyl]-phosphate) was synthesized in 6 steps (see Helv. chim. Acta 44: 1961, 1622). A yield of 64% was obtained, with the high specific activity of 12.1 mc/g.

576 Anliker, R., Beriger, E., Geiger, M., Schmid, K. ÜBER DIE SYNTHESE VON PHOSPHAMIDON* UND SEINEN ABBAU IN PFLANZEN. (The synthesis of phosphamidon and its decomposition in plants.) Helv. chim. Acta 44, 6 (1961) 1622-45. (In German, with English summary).

The synthesis of phosphamidon, a new systemic insecticide, is described. By use of the C^{14}-labelled compound it is shown that in the bean plant phosphamidon undergoes rapid degradation, during which traces of the metabolites desethylphosphamidon, α-chloroacetoaceto-diethylamide, and α-chloroacetoaceto-ethylamide only are detectable. In order to explain the mechanism of the degradation reactions, the behavior of phosphamidon towards acids and bases was studied. (Auth.)

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* 2-chloro-2-diethylcarbamoyl-1-methylvinyl dimethyl phosphate

II-D-p RUELENE

577* Muelder, W.W. 138th Meeting, American Chemical Society, New York, September 1960. Abstr. p. 7A.

Means of synthesizing P^{32}-labelled Ruelene are described.

578 Timmerman, J.A., Jr. TOXICOLOGICAL STUDIES OF ORGANOPHOSPHATE ANTHELMINTICS. *Diss. Abstr.* 24, 5 (1963) 2196-7.

The metabolism, deposition of residues in tissues, excretion rates and stability of Ruelene® (4-*tert*-butyl-2-chlorophenyl methyl methylphosphoramidate) and Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate) in sheep were investigated. In one experiment, P^{32}-labelled Ruelene (50 mg/kg) was administered orally. In other experiments, P^{32}-labelled Bayer 22408 and Ruelene were administered orally and the 4 sheep sacrificed 7 d after treatment. Ruelene residues in several tissues were below 0.4 ppm, while Bayer 22408 residues were below 1.0 ppm. Ruelene was degraded at the P-O-C and the P-N bond forming at least 8 hydrolytic products, 4 of which were identified. Bayer 22408 underwent oxidation at the P=S group and hydrolysis at the P-O-N bond. When Bayer 22408 and Ruelene were formulated as polymers and administered to sheep, there was reduced intestinal absorption of these toxicants, a decrease in the quantity of residues in internal tissues, the phosphate of the toxicants did not undergo enzymatic degradation, and a larger percentage of the administered material was eliminated in the faeces. The anthelmintic efficiency of Ruelene and Bayer 22408 formulated as polymers was compared with standard commercial wettable powder and liquid drench formulations.

II-D-q SARIN

579 Blank, I.H., Griesemer, R.D., Gould, E. THE PENETRATION OF AN ANTICHOLINESTERASE AGENT (Sarin) INTO SKIN. II. AUTORADIOGRAPHIC STUDIES. *J. invest. Derm.* 30 (1958) 187-91.

Sarin (isopropyl methylphosphonofluoridate), an esterase inhibitor similar to DFP, penetrates intact living skin. From the autoradiographic studies presented here, and from many others made in this laboratory, no evidence has been obtained to show that Sarin penetrates preferentially through the hair follicles. Penetration appears to be primarily transepidermal. The autoradiograms are similar whether Sarin is applied to the intact skin during life (rabbits) or to skin excised after death. Intactness of the barrier is important in limiting the penetration of Sarin through the skin. Evidence is shown that a considerable amount penetrates into the dermis during a period of only 5 min when there is even the most superficial break in the barrier. No such penetration through normal, unscratched skin could be demonstrated after 30 min. (Auth. concl.)

580 Fredriksson, T. PERCUTANEOUS ABSORPTION OF SARIN AND TWO ALLIED ORGANOPHOSPHORUS CHOLINESTERASE INHIBITORS. *Acta derm.-venereol.*, Stockh., Suppl. 41 38 (1958) 88p. (In English).

The isopropyl (Sarin) (I), 1-methylbutyl (II), and 1-methylhexyl (III) derivatives of methylphosphonofluoridate were investigated. P^{32}-labelled inhibitors were synthesized according to Collomp (Bull. Inf. Scient. Min Guerre (Sect. tech. de l'Armée), Paris 1949, No. 23 G, 1). I b_8 41°, n_D^{25} 1.3965, II $b_{4.5}$ 60°, n_D^{25} 1.3975, III $b_{0.5}$ 65°, n_D^{25} 1.4125. Percutaneous (Pc) absorption experiments are carried out with undiluted compounds. With dogs and cats no differences are noted between Pc addition and slow, intravenous infusion of I in regard to symptoms, respiratory and circulatory behaviour, or gross pathology. Acetyl-cholinesterase of arterial blood erythrocytes and butyryl-cholinesterase from plasma are inhibited to a maximum of 75% in 10-20 min following Pc I. Pc application elicits local muscular fibrillation and subcutaneous edema and hyperemia. Dilation and increased permeability of cutaneous blood vessels are explained by inhibition of acetylcholinesterase. Washing the guinea pig skin with a 5% soap solution after application of I enhanced survival. LD_{50} in the guinea pig in mg/kg body wt, for Pc application of the compounds to 0.4 cm are I 5.6, II 8.1, III 29.0; for intravenous injection of aqueous solutions. 0.027, 0.052, 0.104, and for subcutaneous injection of aqueous solutions 0.054, 0.069, 0.28, respectively. On using P^{32}-labelled compounds constants were obtained for their disappearance rates from the skin following Pc application: I 0.0010, II 0.0018, III 0.0008 min^{-1}. Radioactive material is found diffused throughout the dermis and concentrated in hair follicles. Butyrylcholinesterase from cat plasma was inhibited 50% by about 3×10^{-9} M I, II, or III. The acetylcholinesterase activity of the derma in different species was estimated for mouse, rat, guinea pig, rabbit, cat, and dog. The spontaneous hydrolysis of I, II, and III, 3.3×10^{-9} M in 0.1 M KCl, and their hydrolysis by homogenates of derma from the guinea pig were determined at pH 7.5 and 37.0°C and expressed as half-life in min. The average for each was I 229 and 125, II 330 and 139, III 389 and 175, respectively. (From CA 55: 1961, 10716g)

581 McPhail, M.K., Adie, P.A. THE DISTRIBUTION OF RADIOACTIVE PHOSPHORUS IN THE BLOOD AND TISSUES OF RABBITS TREATED WITH TAGGED ISOPROPYL METHYLPHOSPHONOFLUORIDATE (Sarin). *Canad. J. Biochem. Physiol.* 38 (1960) 945-52.

Studies have been made of the penetration of P^{32}-labelled Sarin through the skin of rabbits. Sarin vapour at a constant concentration was passed through a plastic cup attached to the clipped bellies of rabbits. Using different sizes of cups it has been found that the L(ct)50 (concentration x exposure time required to kill 50% of the animals exposed) decreased as the exposure area was increased. From these experiments it was possible to determine how absorption through skin varies with area exposed, vapour concentration, and exposure time and to find the approximate ct necessary to kill a rabbit for any area of skin exposed. (Auth.)

II-C-r SCHRADAN

582* Rattan Lal, Rahalkar, G.W., Sethi, G.R., Saxena, P.N. STUDIES ON THE QUANTITATIVE UPTAKE OF P^{32}-LABELLED SCHRADAN BY ADULTS OF *Dysdercus koenigii* Fabricius FROM INSECTICIDAL FILMS. *Indian J. Ent.* 22, 2 (1960) 92-8.

Since little was known of the contact effect of schradan on insects or the extent to which they pick it up from deposits, schradan labelled with P^{32} was used to prepare films on filter papers, and adults of *Dysdercus koenigii* were released on these and observed for mortality daily at a temperature of about 30°C. Uptake was found to be directly related to the concentration of the solution used (0.543, 0.2715 or 0.116%) and to the duration of exposure, but it was also affected by the number of insects exposed per unit area. There was some variation in individual susceptibility of the insects, but the amount picked up from deposits of the higher concentrations was usually more than sufficient to kill them. After being picked up by contact, the insecticide became distributed in the body by way of the haemolymph, and it was eliminated to some extent with the excreta.

II-C-s SUMITHION

583 Kovac, J. DETERMINATION OF O,O-DIMETHYL O-(3-METHYL-4-NITROPHENYL) THIOPHOSPHATE IN TECHNICAL PRODUCTS AFTER PRIOR SEPARATION OF BY-PRODUCTS BY THIN-LAYER CHROMATOGRAPHY. *J. Chromat.* 11, 3 (1963) 412-3. (In German).

Technical O,O-Di-Me O-(3-methyl-4-nitrophenyl) thiophosphate (I), an insecticide, contains also varying amounts of O-Me O,O-bis(3-methyl-4-nitrophenyl) thiophosphate (II), O,O-di-Me O-(3-methyl-4-nitrophenyl) phosphate (III), 3-methyl-4-nitrophenol (IV), O-Me O,O-bis(3-methyl-4-nitrophenyl) phosphate, and several S-alkyl isomers which interfere in the direct determination of I by polarography. These by-products are separated from I by thin-layer chromatography on SiO_2 with petroleum ether (b. 60-80°) containing 1.4 volume % acetone, Rf values of 0.71, 0.36, 0.06, and 0.16 were obtained for I, II, III, and IV, respectively. The by-product spots, viewed in ultraviolet light, are eluted from the plate with MeOH and determined polarographically *in toto*, and the curve obtained is subtracted from that of the technical product to give the I content. The maximum error of the method is ±2%. S^{35}-labelled I in technical I may be purified by paper chromatography with the system olive oil-AcOH, dissolved in hexane, and shaken with an equal volume of MeCN; I remains in the MeCN layer and the oil remains in the hexane layer. The partition coefficient of I in this system is 38. (CA 59: 1963, 14511h)

584 Miyamoto, J., Sato, V., Kadota, T., Fujinami, A., Endo, M. STUDIES ON THE MODE OF ACTION OF ORGANOPHOSPHORUS COMPOUNDS. PART I. METABOLIC FATE OF P^{32}-LABELED SUMITHION AND METHYL PARATHION IN GUINEA PIG AND WHITE RAT. *Agric. Biol. Chem.*, Japan 27, 5 (1963) 381-9.

An explanation was sought of the low mammalian toxicity of Sumithion® [O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate, also known as Bayer 41831 or Folithion]. Experiments were made using P^{32}-labelled Sumithion and methyl parathion on guinea pigs, rats, the German cockroach, *Blattella germanica* (L.), and rice followed by chromatographic separation and identification of metabolites in the excreta. Results of such in vivo studies indicated that the comparatively low mammalian toxicity of Sumithion is probably due to the ability of the mammal to degrade the insecticide in a more efficient manner than insects.

II-D-t THIMET

585 Costa, J.J., Ghelfi, R.A., Brenzoni, E.O. PENETRACION Y TRASLACION DE UN INSECTICIDA SISTEMICO. Informe No.18. Argentina, Comisión Nacional de Energía Atomica, Buenos Aires. 1963. 19p. (In Spanish, with English summary)

P^{32}-labelled Thimet (phorate) was applied to barley plants in a greenhouse experiment, by either painting the leaves, irrigating the soil, or treating the seeds. Autoradiographs confirmed penetration in every case, with translocation throughout the entire plant and a markedly higher level of radioactivity in the upper part of the leaves. Optimum insecticide concentrations, such that the plant was not damaged, with yet enough to obtain satisfactory autoradiographs (phorate 1.1 mc/mM), were found to be as follows: topical application to leaves 2 ‰ of the product in an emulsion consisting of a derivative of sulphonated polyethyleneglycol, xylol, and water; irrigation - same emulsion but 0.4% phorate; seed treatment - same emulsion but 0.2% phorate when the seeds were soaked, and 2% (with reference to seed weight) when activated charcoal was used.

II-D-u TROLENE

586 Adkins, T.R. Jr. SYSTEMIC ACTION OF TWO INSECTICIDES ON ARTHROPOD PARASITES OF RABBITS AND CATTLE. Diss. Abstr. 21, 12 (1961) 3890-1.

Experiments were conducted on the toxicity of Dipterex (Bayer L 13/59; O,O-dimethyl-2,2,2-trichloro-1-hydroxyethyl-phosphonate) to Amblyomma maculatum Koch, and of Trolene (Dow ET-57; O,O-dimethyl-O-2,4,5-trichlorophenyl-phosphorothioate) against Hypoderma lineatum (DeVill.). Part of the thesis is concerned with investigations into the systemic action of P^{32}-labelled Trolene in domestic rabbits. These were treated with 50, 75, 100 and 200 mg radioactive Trolene/kg body weight. Blood samples were collected from the marginal ear vein at intervals, and simultaneously 5th-instar bed bugs (Cimex lectularius) were allowed to take blood meals from the treated rabbits. Percentage mortalities of these bugs were used for bioassay studies. The quantity of radioactive material in the blood fluctuated (3 or 4 peak concentrations but no levelling off). Bioassay indicated fluctuating levels of toxicant, not consistently correlated with radiological assay. Some mechanism might limit the absorption of chemical through the gut wall into the blood stream. When concentrations of radioactive material in the blood reached high levels, bleeding was difficult, blood proved more viscous and clotted faster than normal, and bugs fed slowly or not at all. Rabbits died when the radioactive chemical in the blood reached the concentration levels 18.6, 23.6, 41.6, 72.4, and 107.0 µg equiv./ml.

II-D-v VARIOUS

587 Dedek, W. DIE DARSTELLUNG ^{32}P-MARKIERTER PHOSPHORBROMIDE ALS AUSGANGSSUBSTANZEN FÜR SYNTHESEN ^{32}P-MARKIERTER PHOSPHORORGANISCHER INSEKTIZIDE. (Preparation of P^{32}-labelled phosphorus bromides as starting materials for the synthesis of P^{32}-labelled organo phosphorus insecticides). Isotopen Tech. 1, 7 (1961) 195-6. (In German).

Detailed procedures are given for the preparation of products with specific activities dependent only on the yield of the reaction and the specific activity of the labelled P used. $P^{32}Br_3$ was prepared in 80-5% yield from labelled red P and Br in CS_2. $P^{32}Br_5$ was prepared similarly and treated drop-wise, with cooling, with a solution of absolute EtOH in CS_2 to give 82-5% $P^{32}OBr_3$. $P^{32}SBr_3$ was prepared in 57-9% yield by adding Br to a suspension of red P^{32}, S, and $AlCl_3$ in CS_2. (CA 56: 1962, 15120g)

588* Rus[illegible] K., Szuchnik, A. PREPARATION OF SODIUM α-NAPHTHYL PHOSPHATE AND PHOSPHORUS O[illegible]HLORIDE LABELLED WITH P^{32}. NP-8155, Atomic Energy Commission, Washington, D.C. 1959. 1[illegible]

A semi-micromethod for the preparation of P^{32}-labelled di-Na α-naphthyl phosphate and $POCl_3$ from hydrated labelled H_3PO_4 and PCl_5 is presented. This represents a stepping stone in the synthesis of labelled organophosphorus insecticide.

589* Kalinsky, J.L., Weinstein, A. IMPROVED PROCEDURE FOR SYNTHESIS OF P-32 PHOSPHORUS OXYTRICHLORIDE. J. Amer. chem. Soc. 76 (1954) 5882.

As a starting point for the synthesis of certain P^{32}-labelled insecticides phosphorus oxytrichloride is required. A method is described, starting with the dehydration of aqueous $H_3P^{32}O_4$ for obtaining $P^{32}OCl_3$ of high specific activity (0.78 mc/mM) and chemical purity (97±1%). The specific activity was determined by conversion into P^{32}-labelled tricresyl phosphate and subsequent assay.

Phosphoric acid esters

590 Dedek, W., Grimmer, F., Koch, H. RADIOAKTIV MARKIERTE PHOSPHORSÄUREESTER. I. MITTEILUNG: DARSTELLUNG DER ^{32}P-MARKIERTEN ISOMEREN DES β-METHYLMERCAPTOÄTHYL-THIOPHOSPHORSÄUREDIMETHYLESTERS UND IHR HYDROLYTISCHER ABBAU IN DER PFLANZE. (Radioactive-labelled phosphoric acid esters. I. Preparation of P^{32}-labelled isomers of the β-methylmercaptoethyl thiophosphoric dimethyl ester and their hydrolytic breakdown in the plant). Isotopen Tech. 2 (1962) 150-7. (In German).

The various steps in the synthesis of this systemic insecticide are described, and details of the chromatographic separation procedure given. The hydrolytic breakdown products of the P^{32}- and S^{35}-labelled isomers and of their oxidation products are traced. Tomato plants were treated in the field and their residue analyzed subsequently.

591 Dedek, W. RADIOAKTIV MARKIERTE PHOSPHORSÄUREESTER. II. MITTEILUNG. DARSTELLUNG UND HYDROLYTISCHER ABBAU VON ^{32}P-MARKIERTEM DIPTEREX. (Radioactive-labelled phosphoric acid ester. II. Preparation and hydrolytic breakdown of P^{32}-labelled Dipterex). Isotopen Tech. 2, 6 (1962) 182-5. (In German).

The preparation is described of P^{32}-labelled phosphorus trichloride ($P^{32}Cl_3$) which, in turn, can be used to give dimethyl phosphite $(CH_3O)_2P^{32}\genfrac{}{}{0pt}{}{\nearrow O}{\searrow H}$ from which Dipterex $(CH_3O)_2P^{32}\genfrac{}{}{0pt}{}{\nearrow O}{\searrow CH(OH){-}CCl_3}$ and DDVP (dimethylchlorovinyl phosphate) $(CH_3O)_2P^{32}\genfrac{}{}{0pt}{}{\nearrow O}{\searrow O{-}CH{=}CCl_2}$ can be obtained. Selective extraction of Dipterex breakdown products from an aqueous solution is described.

592 Dedek, W., Kühnert, M. RADIOAKTIV MARKIERTE PHOSPHORSÄUREESTER. III. MITTEILUNG: DAS VERHALTEN VON ^{32}P-MARKIERTEM WOTEXIT BEI INTRAVENÖSER UND INTRAMUSKULÄRER INJEKTION AN RINDERN. (Radioactive-labelled phosphoric acid esters. III. The fate of P^{32}-labelled Wotexit following intravenous or intramuscular injection in cattle). Isotopen Tech. 2, 6 (1962) 307-9. (In German).

Four experiments were carried out with intravenous and three with intramuscular injection of "Bubulin" which contains Wotexit (O,O-dimethyl-1-hydroxy-2,2,2-trichloroethylphosphonate). The data obtained from the different series are plotted. The radioactivity of extracts was corrected by a distribution coefficient. Results indicate the absence of serious persisting side effects when "Bubulin" is injected.

593 Kovac, I., Novomeska, E. REPORT ON THE SYNTHESIS AND APPLICATION OF P^{32}-LABELLED DIALKYLDITHIOPHOSPHORIC ACID ESTERS. Sektion Chemie im Rat für gegenseitige Wirtschaftshilfe, Sofia 1961.

Thiophosphoric esters

594 Dubini, M. SYNTHESIS OF THIOPHOSPHORIC ESTERS LABELED WITH ^{32}P. Ann. Chim., Rome 53, 10 (1963) 1421-6.

$(MeO)_2P^{32}(S)SCHPhCO_2Et$ (I) and $(MeO)_2P^{32}(O)SCHPhCO_2Et$ (II), useful for the biochemical study of the analogous inactive compounds, that have interest as insecticides were prepared. To prepare I (Ital. 561 501) 0.45 g red irradiated P and 1.18 g S was heated 3 h at 300° in CO_2 atmosphere and cooled, 10 ml toluene and 2 ml anhydrous MeOH added, and the mixture maintained 3 h at 80°. The filtered liquid was agitated with N to eliminate H_2S, then 2 ml H_2O with phenolphthalein added, and the solution neutralized with NaOH. The aqueous layer was separated, 2,62 g $BrCHPhCO_2Et$ and 4 ml acetone added, the solution agitated 22 h at ambient temperature, 10 ml toluene added, and agitation continued 30 min. The organic layer was dried over anhydrous Na_2SO_4, filtered, chromatographed (acid alumina), and distilled in a rotating evaporator at 80-100°/1 mm to eliminate solvent and Br derivative and to yield 2,52 g I, n_D^{20} 1,5538. To prepare II (Ger. 1,011,416, CA 54, 24551e), $(MeO)_2P^{32}ONa$ was prepared by irradiation of the compound followed by distillation to eliminate decomposition products and, by P^{32} exchange with $H_3P^{32}O_4$. An acid solution of carrier-free $H_3P^{32}O_4$ (0,2 ml) (activity 0,5 mc) and 0,6 ml H_3PO_4 was evaporated 10 h *in vacuo*, then 4,9 g $(MeO)_2PONa$ added, the whole heated in a closed tube 24 h at 70-80°, the organic layer distilled at 18 mm, and the radioactivity determined (1,5% introduced). MeOH (12 ml) and 310 mg Na was agitated until complete solution of Na in N atmosphere and cooled to 0,5°, 1,5 g activated $(MeO)_2PONa$ added under a slow current of N, the mixture agitated 2 h, treated with 435 mg S powder, agitated 3 h at 0,5° and 15 h at ambient temperature, filtered, and evaporated *in vacuo*, anhydrous ether added, the product filtered off after 4 h and treated with 9 ml $BrCHPhCO_2Et$, the mixture agitated 2 h at 70°, 5 ml water added, the organic layer extracted with Et_2O, dried (Na_2SO_4), and evaporated, and the residue distilled at 170-80°/1 mm to give 1,9 g II, n_D^{20} 1,5220. (CA 60: 1964, 6777f)

595 Fontana, P., Silva, S. ASSORBIMENTO RADICALE DI *O,O* DIMETIL-*S*-BENZEN SOLFONIL DITIOFOSFATO CONTÈNENTE ^{32}P. (Radical absorption of P^{32}-labelled *O,O*-dimethyl-*S*-benzene sulfonyl phosphorodithioate). *Energia nucl.*, Milano *10*, 3 (1963) 141-5. (In Italian, with English summary).

Procedures for the synthesizing the P^{32}-labelled insecticide were studied and the compound administered to tomato plants (*Licopersicon esculentum*) in order to follow its radical absorption. The pesticide is absorbed only slightly and only shortly after treatment, and undergoes rapid and conspicuous hydrolysis both in the soil and the plant itself.

See also:

500 A new bioassay technique, with special reference to the specific bioassay of DDVP insecticide. (Sun and Johnson, 1963)
630 Distribution and metabolism of P^{32}-labeled diisopropyl phosphorofluoridate in the American cockroach, *Periplaneta americana.* (Iyatomi *et al.*, 1957)
631 Mechanisms of resistance in Diazinon-selected multi-resistant *Musca domestica.* (Forgash *et al.*, 1962)
632 Absorption and metabolism of dimethoate(*) in the bollworm and boll weevil. (Bull *et al.*, 1963)
633 Metabolism of Imidan in insects. (Menn and McBain, 1963)
636 Metabolism of malathion and malaoxen by the mosquito, *Culex tarsalis* Coq. (Bigley and Plapp, 1962)
637 Metabolism of malathion in susceptible and resistant house flies. (Bigley and Plapp, 1963)
638 The permeability of insect cuticle. (Matsumura, 1959)
640 Biochemical study of a malathion-tolerant strain of *Aedes aegypti.* (Matsumura and Brown, 1961)
641 Histochemistry of malathion resistance in the encephalitis mosquito, *Culex tarsalis* Coq. (Mengle and Lewallen, 1962)
642 Metabolism of malathion by a resistant and a susceptible strain of *Culex tarsalis:* I. Degradation *in vivo* and identification of organic soluble metabolites. (Mengle and Lewallen, 1963)
643 Selective toxicities of organic phosphorus insecticides. III. An enzyme system included in the cleavage of methyl parathion to demethyl parathion in the supernatant of some types of homogenates. (Fukami and Shishido, 1963)
644 The uptake and metabolism of parathion by insect eggs. (O'Brien and Smith, 1961)
645 Studies on parathion metabolism in normal and parathion-resistant house flies. (Plapp *et al.*, 1961)
646 The toxicological action of three organophosphorus insecticides with three species of mosquito larvae. (Schmidt and Weidhaas, 1961)
649 Absorption and metabolism of Ruelene by arthropods. (Brady and Arthur, 1962)
650 Distribution of P^{32}-labelled schradan in the American cockroach *Periplaneta americana* (L.) (Saito, 1960)
651 Distribution of P^{32}-labelled schradan in various insects [*Periplaneta americana* (L.), *Musca domestica* L., *Chilo suppressalis* (Wlk.), *Nephotettix cincticeps* (Uhl.), *Scotinophara lurida* (Burm.) and *Leptocorisa varicomis* (F.)]. (Saito, 1960)

652 Studies on the selective toxicity of schradan. (Saito, 1963)
656 The penetration and metabolism of Thiodan in *M. domestica.* (Barnes, 1963)
658 Use of radioisotopes in studying the absorption, distribution and elimination of certain insecticides in animals. (Filatov *et al.*, 1963)
661 Metabolism of *O,O*-dimethyl *O*-[4-(methylthio)-*m*-tolyl] phosphorothioate by white rats. (Brady and Arthur, 1961)
663 Studies with P^{32}-labeled Bayer 22408 in steers and guinea pigs. (Gatterdam *et al.*, 1962)
666 Metabolism as factor in selectivity of organophosphate insecticides. (Krueger, 1961)
669 Leukokinetic studies. V. Uptake of tritiated diisopropyl fluorophosphate (DFP) by leukocytes. (Kurth *et al.*, 1961)
670 The distribution and excretion of P^{32}-labeled diazinon in guinea pigs. (Kaplanis *et al.*, 1962)
671 Detection and distribution of ^{32}P labelled diazinon in dog tissues after oral administration. (Millar, 1963)
672 Rumen bacterial and protozoal responses to insecticide substrates. (Williams *et al.*, 1963)
673 The metabolism of P^{32}-labeled dimethoate in sheep. (Chamberlain *et al.*, 1961)
674 Studies on influencing metabolism and on the precipitation mechanism of the phosphonic acid ester, trichlorphon in the commercial product "Bubulin" with the help of ^{32}P-labelled phosphor in the intravenous and intramuscular injection to cattle. (Kühnert *et al.*, 1963)
675 Absorption and elimination of General Chemical 4072 applied dermally to cattle. (Chamberlain and Hopkins, 1962)
676 The metabolism of orally administered malathion by a lactating cow. (O'Brien *et al.*, 1961)
677 New tracer techniques for evaluating the effects of an insecticide on the ecology of a forest fauna. (Peterle and Giles, 1961)
678 Studies on the percutaneous absorption of parathion and para-oxon. II. Distribution of ^{32}P-labelled parathion within the skin. (Fredriksson and Bigelow, 1961)
679 Tissue distribution of P^{32}-labeled parathion. Autoradiographic technique. (Fredriksson and Bigelow, 1961)
680 Penetration and metabolism of two organophosphorus insecticides by the organs of warm blooded animals. (Gar *et al.*, 1959)
682 Metabolism of 2,2-dichlorovinyl dimethyl phosphate in relation to residues in milk and mammalian tissues. (Casida *et al.*, 1962)
683 Mammalian enzymes involved in the degradation of 2,2-dichlorovinyl dimethyl phosphate (DDVP). (Hodgson and Casida, 1962)
684 Metabolism of organophosphate insecticides by plants: a review. (Casida, 1962)
685 Annual Report of the West African Cocoa Research Institute, 1959-60. (West African Cocoa Research Inst, 1961)
686 Studies on the translocation of radioactive schradan in plants and its uptake from film by insects. (Chatterji *et al.*, 1961)
687 Phorate accumulation by cotton plants and recovery from soil. (Hacskaylo *et al.*, 1961)
688 Dimethoate absorption and its translocation and distribution in the cotton plant. (Hacskaylo *et al.*, (1961)
689 Metabolism of dimethoate in cotton leaves. (Hacskaylo and Bull, 1963)
690 Evolution des dépôts superficiels, diffusion et dégradation de deux insecticides endothérapiques: le déméton-S et l'endothion dans quelques plantes maraîchères. (Hascoët, 1963)
691 Absorption and translocation of phorate and phosphorus by cotton seedlings. (Lindquist *et al.*, 1961)
692 Laboratory and field investigations with phorate-treated cotton seeds. (Lindquist *et al.*, 1961)
693 Systemic activity of dimethoate applied to cotton seeds. (Lindquist *et al.*, 1961)
694 Absorption and translocation of Di-Syston by cotton plants. (Tsao and Clark, 1961)
695 Absorption and movement of phosphorus-32-labelled systemic insecticides in the grape vine (*Vitis vinifera* L.) (Coombe, 1962)
697 L'établissement des processus d'absorption et diffusion des insecticides systémiques au *Populus euramericana* dode Guinier "*robusta*". (Catrina *et al.*, 1963)
699 Metabolic fate of malathion and methyl parathion in rice plant. (Tomizawa and Sato, 1962)
700 Fate of *O,O*-dimethyl *O*-(3-methyl-4-methylmercaptophenyl) thiophosphate sprayed on tea and cabbage leaves. (Tomizawa *et al.*, 1962)
703 Residue and metabolism of radioactive 4-*tert*-butyl-2-chlorophenyl methyl methylphosphoramidate administered as a single oral dose to sheep. (Bauriedel and Swank, 1962)
707 Residues in the milk of dairy cows sprayed with P^{32}-labeled general chemical 4072. (Roberts *et al.*, 1961)

708 In vitro stability and recovery of insecticides from milk. (Timmerman et al., 1961)

712 Magnitude and nature of residues in tissues and eggs of poultry receiving Ruelene in the feed. (Buttram and Arthur, 1961)

713 Residues in tissues and eggs of poultry dusted with Co-Ral (Bayer 21/199). (Dorough et al., 1961)

714 Residues in tissues and eggs of poultry receiving Co-Ral (Bayer 21/199) in the feed. (Dorough et al., 1961)

715 Distribution and solubility properties of phosphoric and O,O-diethyl phosphorodithioic acids fed to laying hens. (Dorough and Arthur, 1961)

716 Percutaneous absorption of parathion and paraoxon. IV. Decontamination of human skin from parathion. (Fredriksson, 1961)

718 The detection of residues of Systox and its toxic metabolites in the presence of other organophosphorus pesticides. (Adams et al., 1963)

719 Elimination of residual agricultural chemicals. II. Contamination with Baycid (O,O-diethyl O-(3-methyl-4-methylthiophenyl) thiophosphate). (Danbara and Tomizawa, 1961)

723 Method of determining residues of the insecticide Lebaycid® in plant material. (Frehse et al., 1963)

724 Accumulation of phorate by cotton plants from solution and sand culture. (Hacskaylo et al., 1961)

725 Locale and metabolism of methyl parathion and guthion in the cotton leaf. (Shipp, 1963)

726 Characteristics of residues of methyl parathion applied to field cotton. (Shipp et al., 1963)

727 Residue determinations in olives and various parts of plants of the N-monomethylamide of O,O-dimethyldithiophosphoryl acetic acid (Rogor). (Bazzi, 1960)

728 Determination of residues of ethyl ester of O,O-dithiophosphorylacetic acid [Cidial] in agricultural products. (Bazzi, 1963)

729 The Agricultural Research Institute of the Society of Montecatini: Data on phosphoric ester insecticides in plants and residue evaluations. (Bazzi, 1963)

730 Method of determining residues of the insecticide Lebaycid® in olives and olive oil. (Frehse et al., 1963)

734 Loss of parathion and DDT to soil from aqueous dispersions and vermiculite granules. (Weidhaas et al., 1961)

1570 Use of radioisotopes and radiation in the control of plant and animal insect pests. (Andreev, et al., 1963)

II-E Pyrethrins and Related Compounds

II-E-a PYRETHRINS

596 Fine, B.C., Godin, P.J., Thain, E.M. PENETRATION OF PYRETHRIN I LABELLED WITH CARBON-14 INTO SUSCEPTIBLE AND PYRETHROID RESISTANT HOUSEFLIES. Nature, Lond. 199, 4896 (1963) 927-8.

(C^{14})-pyrethrin I, labelled in the cyclopropane ring adjacent to the ester linkage, was prepared by the esterification of (C^{14})-(±)-trans-chrysanthemum monocarboxylic acid with (+)-pyrethrolone. Details of the procedure are given. Because of the small quantity of material available the (±)-trans-acid could not be resolved and so the final product was a mixture of natural pyrethrin I and one of its diastereoisomers, henceforth referred to as (C^{14})-'pyrethrin I'. Sub-lethal quantities of (C^{14})-'pyrethrin I' in acetone were then applied by topical application to batches of flies of three strains. Results indicate that there is a definite correlation between the rates of absorption of (C^{14})-'pyrethrin I' and pyrethroid resistance in the strains studied here.

597 Godin, P.J., Thain, E.M. BIOSYNTHESIS OF CHRYSANTHEMUMMONOCARBOXYLIC ACID. Proc. chem. Soc. (1961) 452.

Pyrethrin I, labelled with C^{14} derived from mevalonic acid-2-C^{14} in vivo (CA 56, 724f), yielded chrysanthemummonocarboxylic acid-C^{14} (I) on alkaline hydrolysis without loss of radioactivity. Ozonolysis of I gave Me_2CO-C^{14} and caronic acid-C^{14} (II). Me_2CO was converted to $C^{14}HI_3$ and Kuhn-Roth oxidation of II gave AcOH with 50% of the radioactivity of II. This confirmed the sites of C^{14}-labelling in I to be as shown and established that I was formed in the plant from two isoprenoid units. (CA 56: 1962, 11452c)

598* Levy, W.L., Munou, M.O., Muggia, F.M., Jimenez, J.O. Pyrethrum Post 5 (1960) 3-?

On the breakdown and synthesis of naturally occurring pyrethrum insecticides.

II-E-b ROTENONE

599 Nishizawa, Y., Casida, J.E. RADIOSYNTHESIS OF ROTENONE-8-C^{14}. (Abstr. 64). Bull. ent. Soc. Amer. 9, 3 (1963) 164.

Reaction of ethyl bromoacetate-1-C^{14} with derritol yielded dehydrorotenone-8-C^{14} in 50% yield. Sodium boron hydride reduction gave rotenol, and subsequent Oppenauer oxidation yielded mutarotenone-8-C^{14} (see Miyano and Matsui, Berg. 91: 1958, 2044) in about 25% yield. Heating the mutarotenone gave natural rotenone-8-C^{14} in about 10% overall yield from ethyl bromoacetate-1-C^{14}.

II-F Nicotine. Carbamates and Other Compounds

II-F-a NICOTINE

600 Griffith, G.D. THE BIOLOGICAL OXIDATION OF NICOTINE. I. NICOTINE DEGRADATION BY Nicotiana rustica. II. NICOTINE DEGRADATION BY AN Arthrobacter SPECIES. Diss. Abstr. 22, 2 (1961) 416.

Metabolism of nicotine in the tobacco plant has remained largely unexplored, although it has been demonstrated that the alkaloid is not an inert plant constituent but can be converted to other materials. In the present study C^{14}-labelled nicotine was supplied to tobacco plants and nicotine, nicotinic acid, and cotinine were isolated after periods of metabolism of 4, 7, or 14 d. Approximately 60-80% of the total radioactivity fed to the plants was recovered as nicotine dipicrate in all experiments. Nicotinic acid isolated as the hydrochloride, contained a significant amount of isotope. The production of nicotine acid from nicotine in the tobacco plant suggests that the alkaloid may serve as a reserve source of this compound. A species of Arthrobacter resembling Arthrobacter oxydans was isolated in the nutrient medium in which tobacco plants had been grown. The bacteria catalyzed the production of 6-hydroxynicotine in approximately 50% yield from nicotine in a medium containing nicotine, inorganic salts and a small amount of yeast extract. The significance and implications of the findings are discussed.

601 Griffith, T., Byerrum, R.U. BIOSYNTHESIS OF THE PYRIDINE RING OF NICOTINE FROM SUCCINATE AND ACETATE. Biochem. Biophys. Res. Commun. 10 (1963) 293-7.

Tobacco plants (Nicotiana rustica) were fed acetate-2-C^{14} (I) and succinate-2,3-C^{14} (II). Specific degradations of nicotine were carried out for isolation and assays of carbons 2, 3, and 6 of the pyridine ring. With I, the percent distribution of activity was 38, 34, and 11, respectively, and with II, 39, 39, and 7. It is suggested that carbons 2 and 3 of the pyridine ring arise from the methylene carbons of succinate or a closely related acid. (CA 58: 1963, 14358c)

602 Il'in, G.S., Feier-Kossei, O.G. INFLUENCE DU CHLORAMPHÉNICOL SUR LA BIOSYNTHÈSE DE LA NICOTINE. Dokl. Akad. Nauk SSSR 153, 2 (1963) 470-2. (In Russian, with French summary).

603 Il'in, G.S. BIOSYNTHESIS OF NICOTINE IN THE TOBACCO PLANT. Fiziol. Rast. 10, 1 (1963) 79-83. (In Russian, with English and French summaries).

In experiments with Nicotiana tabacum, intensive synthesis of nicotine (I) follows the use of $C^{14}H_3COONa$ (II) or $C^{14}H_3NH_2 \cdot HCl$ (III) as substrate. II enters the pyridine and pyrollidine rings, whereas III is only incorporated in the pyrollidine ring. I-content remains roughly constant due to both synthesis and breakdown. When the seeds mature there is not only incorporation of I from the vegetative organs but biosynthesis of I also takes place. (Translated from Chem. Zblt. 134,44-1:1963, 19289. MB)

604 Krampl, V. THE ROLE OF Δ^1-PYRROLINE-5-CARBOXYLIC ACID IN THE BIOSYNTHESIS OF THE PYRROLIDINE RING OF NICOTINE. Diss. Abstr. 22, 2 (1961) 418-9.

Ornithine-2-C^{14}, glutamic acid-2-C^{14}, proline-C^{14}, and putrescine-1,4-C^{14} have been found to be efficient precursors for biogenesis of the pyrrolidine ring of nicotine. The objective of the present study was to investigate the participation of Δ^1-PC-5 in the biogenesis of nicotine. Dl-Δ^1-pyrroline-5-carboxylic acid-5-C^{14} was synthesized, isolated as a hydrochloride and fed hydroponically to intact 3 months old tobacco plants. Each plant received 1-2 mg of dl-Δ^1-PC·HCl-5-C^{14} ($2.0 - 4.0 \times 10^6$ cpm). The isolated nicotine was radioactive, specific activities ranging from 4.5 to 0.6×10^6 cpm/mM which corresponds to 0.14 - 0.02% incorporation of the precursor. - The feeding technique employed is described. After expiration of the feeding period (7 d), ~ 25% of the radioactivity originally fed to the plants was still recoverable, the main peak still corresponding to that of the original solution fed. The relatively high incorporation of radioactivity into the *N*-methyl group is the only significant difference from the labelling pattern obtained with other known precursors of the pyrrolidine ring of nicotine. Implications of results are discussed. Previous findings indicating roots of tobacco plants as the main site of nicotine biosynthesis and leaves as nicotine depots are supported.

605 Tso, T.C. NORNICOTINE AS A PRECURSOR OF NICOTINE IN *Nicotiana* PLANTS. *Bot. Bull. Acad. sinica* *4*, 2 (1963) 75-79. (In Chinese, with English summary).

Tobacco plants (*Nicotiana rustica* L. var. brasilia) were placed in tritiated water. The biosynthesis of nicotine was traced *via* a precursor, nornicotine, by a mechanism involving alkaloid biosynthesis.

II-F-b CARBAMATES

606 Casida, J.E. MODE OF ACTION OF CARBAMATES. *Annu. Rev. Ent.* *8* (1963) 39-58.

Review. The various aspects considered by the author are general pharmacology, correlation of structure and activity, hydrolysis, *in vitro* and *in vivo* reaction with esterases, metabolism in mammals, plants, and insects. Studies using radioisotopes are cited, also some unpublished results obtained by H.W. Dorough, N.C. Leeling, J.G. Krishna and J.E. Casida in administering carbonyl-C^{14}-labelled Sevin (1-naphthyl methylcarbamate) to houseflies, rats, and bean and cotton plants.

607 Casida, J.E. RADIOTRACER APPROACHES TO CARBAMATE INSECTICIDE TOXICOLOGY. p.223-38 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Dimethylcarbamates have been prepared with carbonyl-C^{14}-labelling and methylcarbamates with methyl; carbonyl- and ring-labelling utilizing carbon-14. The pharmacological action of these compounds presumably results from acetylcholinesterase inhibition and may involve carbamylation. Reaction of carbonyl- or methyl-labelled carbamates with purified cholesterase or other esterases would allow a critical examination of this carbamylation reaction and the ease of spontaneous and the ease of spontaneous and induced reactivation or decarbamylation. The physiological significance of cholinesterase inhibition might be examined by administering acetate-C^{14} and analysis for radiolabelled acetylcholine accumulation in nervous tissue, or by utilizing acetyl-C^{14}-choline as the substrate for *in vitro* determination of the degree of cholinesterase inhibition in tissues of poisoned animals with minimal dimution of the inhibitors and enzymes during analysis. Some progress has been made with radiolabelled materials in investigating the metabolism of carbamate insecticides. Sevin (1-naphthyl methylcarbamate) has been most extensively studied along with its potential hydrolysis products. The assumption that the metabolism of Sevin involves an initial hydrolysis and then further decomposition of the fragments was not supported by carbon-14 studies. The major detoxification mechanism in mammals, and probably also in insects, results from initial oxidative attack on the carbamate by the microsomes in the presence of reduced nicotinamide-adenine dinucleotide phosphate. Sevin is rapidly metabolized in mammals, but the fate of certain of the fragments has not been resolved. Some of the metabolites appear in the milk of lactating animals. One step in the metabolism appears to be formation of the *N*-methylol derivative. Preliminary studies on the metabolism of radiolabelled Dimetilan (2-dimethyl-carbamyl-3-methylpyrazolyl-(5)-dimethylcarbamate) and a related compound in cockroaches also indicate that oxidative attack forms *N*-methyl *N*-methylol derivatives. (From auth.)

608 Casida, J.E. RADIOTRACER STUDIES ON THE MECHANISM OF INSECTICIDAL ACTION. (Abstr. K1B230) p.162 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

The metabolism of carbamate insecticides will be intensively investigated using C^{14}-labelled materials. Dimethylcarbamates labelled in the carbonyl grouping and *N*-methylcarbamates labelled in the carbonyl, methyl and aromatic groups will be considered. Compounds to be examined will include the dimethylcarbamate, dimetilan, and the *N*-methylcarbamates of 1-naphthol, *o*-isopropoxyphenol, *m*-isopropylphenol, 4-methylthio-3,5-xylenol and 4-dimethylamino-3,5-xylenol. Characteristics of the compounds to be considered include residual persistence and fate in plants, metabolic pathway and rate of detoxication in mammals, enzymatic mechanisms of detoxication, resistance mechanisms and the mode of action of synergists.

609 Dorough, H.W., Casida, J.E. NON-HYDROLYTIC PATHWAY IN METABOLISM OF SEVIN. (Abstr. 62). *Bull. ent. Soc. Amer.* *9*, 3 (1963) 163.

The metabolism of C^{14}-tagged Sevin by rat liver microsomes, insects, and plants was examined. At least 8 metabolites, 5 of which were carbamates, were formed by the microsomes and insects. Most of these metabolites were absent in plants. The nature of the products will be discussed.

610 Dorough, H.W., Leeling, N.C., Casida, J.E. NON-HYDROLYTIC PATHWAY IN METABOLISM OF *N*-METHYLCARBAMATE INSECTICIDE. *Science* *140* (1963) 170-1.

C^{14}-labelled Sevin was used. Sevin (1-naphthyl *N*-methylcarbamate), when metabolized by rat liver microsomes and insects (*Musca domestica* L. and *Periplaneta americana* (L.)) yielded at least 5 carbamate metabolites involving modifications of both the methyl group and ring. Certain of these metabolites appeared in milk when Sevin was fed to a goat. The metabolism of *o*-*iso*propoxyphenyl *N*-methylcarbamate by liver microsomes, insects and plants was compared to that of Sevin.

611 Eldefrawi, M.E., Hoskins, W.M. RELATION OF THE RATE OF PENETRATION AND METABOLISM TO THE TOXICITY OF SEVIN TO THREE INSECT SPECIES. *J. econ. Ent.* *54*, 3 (1961) 401-5.

Sevin$^{(R)}$ (1-naphthyl *N*-methylcarbamate) labelled with C^{14} has been used on three insect species by topical application in acetone. Sevin is absorbed rapidly into house flies (*Musca domestica* L.), 75% of a dose penetrating within 4 h. It is rapidly metabolized and excreted, so final toxicity is low as shown by the LD_{50} = 2.0 µg/♀. Resistant house flies differ from susceptible ones only in greater metabolism and consequent lower mortality. If metabolism is prevented by addition of a synergist such as sesamex, the toxicity of Sevin is increased up to 50-fold, and much of the absorbed Sevin remains in the body unchanged. The critical step is the hydrolysis of Sevin to 1-naphthol and methyl amine, which is controlled by a carbamate esterase enzyme. When this is inhibited, e.g., by sesamex, the toxicity is high. Sevin penetrates more slowly into the large milkweed bug (*Oncopeltus fasciatus* (Dall.)), e.g., 40% of an applied dose enters in 8 hours. It is metabolized and excreted very slowly so that LD_{50} is low, i.e., 0.5 µg/insect. The German cockroach (*Blattella germanica* (L.)) absorbs Sevin slowly and metabolizes it rapidly. This results in low toxicity, LD_{50} = 20 µg/♂. The metabolic products are different in the three species and are formed by different reactions. (Auth.)

612 Krishna, J.G., Dorough, H.W., Casida, J.E. RADIOLABELED INSECTICIDES; SYNTHESIS OF *N*-METHYLCARBAMATES *VIA* METHYL ISOCYANATE-C^{14} AND CHROMATOGRAPHIC PURIFICATION. *J. agric. Food Chem.* *10*, 6 (1962) 462-6.

The increasing interest in *N*-methylcarbamates as insecticides prompted their radiolabelling. A convenient radiosynthesis procedure is reported for Sevin (1-naphthyl-*N*-methylcarbamate), Hercules 5727 (Union Carbide 10854, the *N*-methylcarbamates of *m*-*iso*propylphenol), Bayer 39007 (*o*-*iso*propoxyphenol), Bayer 37344 (4-methylthio-3,5-xylenol), and Zectran (4-dimethylamino-3,5-xylenol). Acetyl-C^{14} chloride and sodium azide were reacted to yield methyl *iso*cyanate-C^{14} which was then reacted with the appropriate phenol. A two-compartment reaction tube with a break-seal was utilized. Yields on a 0.5 mM scale were routinely 40 to 70%. Chromatographic procedures for isolating the *N*-methyl carbamates from their reaction mixtures are reported.

613 Leeling, N.C., Krishna, J.G. CONJUGATES OF CARBAMATE METABOLISM OF SEVIN. (Abstr. 61) *Bull. ent. Soc. Amer.* *9*, 3 (1963) 163.

Administration of Sevin-C^{14} to rats resulted in excretion of about 2/3 of the dose in the urine as conjugates of hydroxylated metabolites with the carbamyl group intact. Enzymatic preparations of rat liver were used to examine the nature of these conjugation systems. Evidence for hydroxylated metabolites of Sevin was found.

II-F-c ARSENIC

614* Saito, K., Ikeda, S., Saito, M. THE SEPARATION OF RADIOACTIVE ARSENIC FROM GERMANIUM IRRADIATED WITH PROTONS. Bull. chem. Soc. Japan 33, 7 (1960) 884-7. (In English).

In order to obtain As^{74} of high purity and specific activity as a tracer or for other purposes, chemically pure (99.999999%) Ge and (99.999%) GeO_2 were irradiated in the INS cyclotron with protons from 10 to 14 MeV. The irradiated target contained $As^{70,71,72,73,74}$ and ^{76}, as well as Ge^{69} and ^{71}, and small amounts of $Ga^{67,68,70}$ and ^{72}. At a current density of 15 μA and a duration of 5 h, the total radioactivity was of the order of several-ten mc, and the amount of As^{74} appeared to be 1 mc or less. The irradiated target was dissolved in aqua regia (30 ml) and the GeO_4 formed was distilled until a residue of 1 ml remained. Then the As_2O_3 was distilled in the presence of 10 N HCl (10 ml) and 9 N HBr (5 ml) in an ice-cooled adapter containing H_2O. Although the As recovery was 94%, very little radioactive As was obtained. The distillate was taken up with H_2SO_4, reduced with KI and Na_2SO_3, and extracted with CCl_4 and diethyldithiocarbamate. All operations were followed with a G-M counter. For measuring the conversion electron spectrum, the As was extracted with HNO_3, mounted on a trace of insulin on a thin polyvinyl chloride foil lined with a thin layer of vacuum-evaporated Al, dried in vacuo, and measured by β-spectroscopy. (TID-6613, suppl. 1)

II-F-d SULFUR

615 Otto, H.L., Winand, M. THE PREPARATION OF CURIE QUANTITIES OF S^{35}-LABELED ELEMENT SULFUR. Int. J. appl. Rad. Isotopes 10, 2/3 (1961) 130-1.

In many preparations of S^{35}-labelled compounds elemental S is the starting material. Usually S^{35} is obtained by irradiating KCl in a reactor which, according to $Cl^{35}(n,p)S^{35}$, gives radiosulfur. The radioisotope is isolated as $H_2S^{35}O_4$ which contains an excess of HCl. A method and an apparatus are described by which a sulfate solution of elemental S of high specific activity can be obtained. (TID-3098, 522)

616 Соколов, В.А., Тихомирова, Е.А., Косолапова, Н.А. РАДИОАКТИВНЫЙ ИЗОТОП СЕРЫ S^{35}. М., Атомиздат. 1960. 25 стр.

Sokolov, V.A., Tikhomirova, E.A., Kosolapova, N.A. THE RADIOSULFUR ISOTOPE, S^{35}. Moscow, Atomisdat. 1960. 25p.

Sections are included on (1) physical properties and methods of obtaining S^{35}; (2) production of preparations containing S^{35}; (3) uses of S^{35}; and (4) safety techniques to be used when working with S^{35}.

* * *

See also:

303 Radiometric assay of acetylcholinesterase. (Winteringham and Disney, 1962)
304 Acetylcholinesterase activity and competitive inhibition at low substrate concentrations. (Winteringham and Disney, 1963)

II-G Insecticide Metabolism in

II-G-1 INSECTS

II-G-1-a GENERAL

617 Agosin, M. PRESENT STATUS OF BIOCHEMICAL RESEARCH ON THE INSECTICIDE RESISTANCE PROBLEM. Bull. World Hlth Org., Suppl. 29 (1963) 69-76.

Review article. Enzymatic detoxication reactions considered are conjugation, oxidation, reduction, dehydrochlorination, and detoxication of heavy metal poisons by reaction with S compounds. Resistance mechanisms to DDT, BHC, Prolan, cyclodiene insecticides, pyrethrins and organophosphurs insecticides are discussed, and a number of studies quoted in which radioisotopes were used.

618 Hopkins, T.L. RADIOISOTOPE TECHNIQUES AND RECENT RESEARCH ON METABOLISM OF INSECTICIDES IN INSECTS. p. 101-9 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Techniques useful for investigations of radioisotope-labelled insecticides and insects and their application to the study of insect mechanisms of resistance are reviewed. Data are presented on the quantitative fate and metabolism of P^{32}-labelled Dipterex, O,O-dimethyl 1-hydroxy-2,2,2-trichloroethyl phosphonate, in normal and Dipterex-resistant houseflies. The resistant fly strain was able to detoxify the insecticide and excrete the water soluble metabolites at a more rapid rate than the normal flies. Metabolites were identified by paper chromatography, and no qualitative differences were found between strains. (From auth.)

II-G-1-b BIDRIN

619 Bull, D.L., Lindquist, D.A. METABOLISM OF RADIO-LABELED SD-3562 IN INSECTS AND COTTON LEAVES. (Abstr. 41). Bull. ent. Soc. Amer. 8, 3 (1962) 154.

The absorption and in vivo metabolism of C^{14} or P^{32} labelled 3-(dimethoxyphosphinyloxy)-N,N-dimethyl-cis-crotonamide (SD-3562) by bollworms (Heliothis zea (Boddie)), boll weevils (Anthonomus grandis Boheman), and excised cotton leaves were studied through the use of standard radiometric techniques.

II-G-1-c CYCLODIENE

620 Brooks, G.T., Harrison, A. METABOLISM AND TOXICITY OF THE "CYCLODIENE" INSECTICIDES. Biochem. J. 87, 1 (1963) 5P-6P.

The relatively low toxicities to the adult housefly, Musca domestica L., of the compounds chlordene (I; heptachlor precursor); 1,2,3,4,9,9-hexachloro-1,4,4a,5,6,8a-hexahydro-1,4-methanonaphthalene (II) and its 6,7-double bond isomer (III) are in the order I > II > III. Studies by gas chromatography and with C^{14}-labelled compounds have shown that this is also the order of epoxide formation in vivo; chlordene forms an appreciable amount of a tentatively identified epoxide; (II) gives a small amount of a similar substance; (III) does not apparently give an epoxide. All 3 compounds are further converted into more polar substances.

II-G-1-d ALDRIN AND DIELDRIN

621 Cohen, A.J., Smith, J.N. FATE OF ALDRIN AND DIELDRIN IN LOCUSTS. Nature, Lond. 189, 4764 (1961) 600-1.

The metabolism and excretion of aldrin and dieldrin in Schistocerca gregaria (Forsk.) were examined quantitatively by means of preparations labelled with Cl^{36}. Solutions contained 2 μg labelled aldrin or dieldrin in 5 μl olive oil (representing about 100 cpm) were injected into the abdomens of 5th instar hoppers. They were subsequently kept at room temperature for 7 d. Any that died during this period and survivors (plus excreta) were preserved under ethanol. This procedure was repeated until enough radioactive solution to provide 40 000 cpm had been injected. The preserved material was homogenised with ethanol and repeatedly extracted with acetone, NH_4OH and HCl in turn until radioactive material representing 40 000 cpm had been recovered. Aldrin and dieldrin were re-isolated from the concentrated extracts. It was found that both materials were excreted slowly, the rate at which aldrin was oxidized to dieldrin being slower than that recorded for Musca domestica L. (Nature 186 (1960) 96). Dieldrin was excreted unchanged and repeated sublethal doses should therefore exert a cumulative action in locusts.

II-G-1-e DDT

622 Abedi, Z.H., Duffy, J.R., Brown, A.W.A. DEHYDROCHLORINATION AND DDT-RESISTANCE IN Aedes aegypti. J. econ. Ent. 56, 4 (1963) 511-7.

Larvae of 6 DDT-resistant and 5 susceptible strains of the yellow-fever mosquito, Aëdes aegypti (L.), were all susceptible to Dilan® (a mixture of 1 part of 1,1-bis(p-chlorophenyl)-2-nitropropane (Prolan) and 2 parts of 1,1-bis(p-chlorophenyl)-2-nitrobutane (Bulan), but the former were resistant to o-chloro-DDT and usually to iso-o-chloro-DDT. DMC was synergistic with DDT, o-chloro-DDT, and iso-o-chloro-DDT for the resistant strains. Paper chromatography revealed DDE as the only metabolite of DDT, other candidate metabolites and water-soluble derivatives being absent; o-chloro-DDE was detected as the only metabolite of o-chloro-DDT. The resistant strains produced more DDE and o-chloro-DDE than the susceptible strains, and this production was apparently reduced by DMC. The following radioactive compounds were used: C^{14}-DDT. a) ring-labelled on the para-carbons (activity 3.22 mc/g) b) chain-labelled on the 1-carbon, i.e. 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane-1-C^{14}, synthesized by J.R.D. (activity 1.75 mc/g) C^{14}-DDE. Made from ring-labelled DDT by refluxing it with 2% KOH in 95% aqueous ethanol for 1 h. o-Chloro-DDT. a) chain-labelled on the 1-carbon (activity 1.52 mc/g) b) chain-labelled on the 2-carbon (activity 1.35 mc/g), both synthesized by J.R.D. o-Chloro-DDE. Made from the 1-carbon-labelled o-Cl-DDT by refluxing it with 2% KOH in 95% aqueous ethanol for 30 min.

623 Bull, D.L., Adkisson, P.L. ABSORPTION AND METABOLISM OF C^{14}-LABELED DDT BY DDT-SUSCEPTIBLE AND DDT-RESISTANT PINK BOLLWORM ADULTS. J. econ. Ent. 56, 5 (1963) 641-3.

A Torreon, Mexico strain of Pectinophora gossypiella (Saunders) adults was found to be 6 times more resistant to DDT at the LD_{50} level and 13 times more resistant at the LD_{90} level than moths from El Paso, Texas. The radioactive (C^{14}-ring-labelled p,p'-DDT had a specific activity of 1850 cpm/μg. Adults were treated topically, with from 0.5 to 3.0 μg of DDT. During the first 24 h after treatment, absorption of DDT was slightly more rapid by moths of the El Paso strain. Dehydrochlorination of absorbed DDT to DDE occurred in adults from both strains, but the detoxification was much more extensive in individuals from the Mexican strain.

624 Cutkomp, L.K., Wattal, B.L. DENSITY-MORTALITY RELATIONS IN MOSQUITO BIOASSAY. (Abstr.94). Bull. ent. Soc. Amer. 9, 3 (1963) 165.

When DDT is tested against Aëdes aegypti larvae the mortality declines with greater densities. Determinations of amounts of DDT picked up indicate that less DDT is picked up per larvae when the density is great. C^{14}-labelled DDT has been used for the determination.

625 Dinamarca, M.L., Agosin, M., Neghme, A. THE METABOLIC FATE OF DDT-C^{14} IN Triatoma infestans. Exp. Parasitol. 12 (1962) 61-72.

Rates of absorption of DDT by nymphs and adults were determined following application of DDT-C^{14} in acetone solution to the ventral abdominal regions of the insects. Absorption in nymphs increased to a maximum of approximately 60% of the amount applied after 72 h and remained constant at this level for at least 480 h. Over 37% of the absorbed DDT was either excreted or metabolized in nymphs. Absorption in adults increased almost linearly from 27% of the amount applied at 72 h to 120 h at which time all adults were dead. Only 9% of the absorbed DDT was metabolized or excreted by adults. Metabolites of DDT were detected by measurement of radioactivities from paper chromatograms of extracts of the insects or their faeces. 5 metabolites, of which 4 were unidentified and 1 was identified as 2,2-bis(p-chlorophenyl)-1, 1-dichloroethylene (I), were detected, but different in quality, composition, and quantity in internal extracts and in faecal extracts of nymphs and adults, and with time. I was the most important metabolite quantity in nymphs; almost 21% of the absorbed radioactivity was found as I in the 1st 24 h. After 48 h, the rate of I production in nymphs decreased. Of the metabolites produced by adults, only 1 unidentified compound was accumulated to a significant extent. Higher resistance of nymphs toward DDT was attributed, at least in part, to differences in absorption and detoxication processes. Pathways for the independent production of I and the unidentified metabolites, linked through participation of reduced triphosphopyridine nucleotide, were proposed. (CA 57: 1962, 10372i)

626 Gast, R.T. FACTORS INVOLVED IN DIFFERENTIAL SUSCEPTIBILITY OF CORN EARWORM LARVAE TO DDT. J. econ. Ent. 54, 6 (1961) 1203-6.

Full-grown corn earworms, Heliothis zea (Boddie), require more than 1000 times as much DDT on a weight basis as small larvae in order to obtain LD_{50} values for topical applications in acetone. Injected DDT in acetone is only slightly less effective on large larvae than on small ones. The non-radioactive DDT was chiefly the p'-isomer obtained by 3 recrystallizations of technical material from hot ethanol (melting point was 106.5°C). Radioactive DDT was synthesized with Cl^{36} in the p-p' position (melting point 106.3°C after recrystallization). When assayed on internal flow proportional counter the DDT gave 25 cpm/μg. Chemical and radiometric analysis showed that lack of penetration by DDT through the integument of the large larvae was the chief factor causing the increase in LD_{50} values. Addition of nonvolatile oils to the topically applied material increases the effectiveness of DDT to the larger larvae. Tests with different colored larvae indicate that light yellow larvae are approximately twice as susceptible as the dark red or black larvae.

627* Hoskins, W.M., Erwin, W.R., Andrews, T. METABOLISM OF DICHLORODIPHENYLTRICHLOROETHANE IN THE GERMAN ROACH. p.1307-9 in "Proceedings of the 4th International Congress of Crop Protection, Hamburg, September 1957. Section 13. Insecticides. Vol.II". Brunswick, 1960.

The metabolism of DDT in Biattella (Blatta) germanica (L.) was investigated by means of topical application of a sample of C^{14}-labelled DDT. This technique, combined with chromatography of extracts and excreta led to the finding of 4 metabolites, all more polar in nature than DDT but differing from DDE (ethylene, 1,1-dichloro-2,2-bis(p-chlorophenyl)-.)

628 Lindquist, D.A., Brazzel, J.R., Davich, T.B. FATE OF DDT AND TOXAPHENE APPLIED TOPICALLY TO SUSCEPTIBLE AND RESISTANT BOLL WEEVILS. J. econ. Ent. 54 (1961) 299-300.

The metabolism of DDT by susceptible and resistant boll weevils (Anthonomus grandis Boh.) treated topically with DDT or DDT plus toxaphene was studied. Little difference was found between strains receiving the same treatments. Extracts of weevils treated with DDT plus toxaphene contained slightly more DDT than those of weevils treated with DDT alone. Poor recovery of the applied DDT was obtained. Tests with C^{14}-labelled DDT indicated that the treated weevils rubbed off much of the toxicant and converted a small quantity to a compound which did not respond to the colorimetric analysis employed. Resistant weevils treated with toxaphene absorbed less than similarly treated susceptible weevils. (Auth.)

629 Perry, A.S., Miller, S., Buckner, A.J. THE ENZYMATIC IN VITRO DEGRADATION OF DDT BY SUSCEPTIBLE AND DDT-RESISTANT BODY LICE. J. agric. Food Chem. 11, 6 (1963) 457-62.

Homogenates and acetone powders of both susceptible and DDT-resistant body lice (Pediculus humanus humanus L.) catalyze the degradation of DDT in vitro. Reduced glutathione, cysteine, ascorbic acid, thioglycollic acid, and coenzyme A may be used as cofactors for activation of the enzyme system. Enzyme preparations when incubated with DDT under optimum conditions yield at least 3 metabolites. On the basis of their neutral or acidic character, ultraviolet and infrared absorption spectra, colorimetric analysis, and paper chromatography, the metabolites have been identified as 2,2-bis-(p-chlorophenyl)-1,1-dichloroethylene (DDE); 4,4-dichlorobenzophenone (DBP); and bis-(p-chlorophenyl)acetic acid (DDA). This is the first demonstration of DDA as a product of DDT metabolism in an insect. C^{14}-labelled DDT was used. (Mostly auth.)

II-G-1-f DFP

630* Iyatomi, K., Saito, T., Kanehisa, L., Nishizawa, T., Naruse, H. DISTRIBUTION AND METABOLISM OF P^{32}-LABELED DIISOPROPYL PHOSPHOROFLUORIDATE IN THE AMERICAN COCKROACH, Periplaneta americana. Botyu-Kagaku 22 (1957) 192-6.

The distribution and metabolism of diisopropyl phosphorofluoridate (I) in the American cockroach topically treated with P^{32}-labelled I were studied. Very small amounts of I were found in the central nervous system, and comparatively large amounts were found in the digestive system and Malpighian tubes. Alcohol-formic acid fractionation revealed that about 10% of the total I taken up by the tissues were acid-soluble phosphorylated compounds and others were not incorporated into the acid-soluble compounds. It may be assumed that only 1/10 of the I in the insect tissues actually inhibits cholinesterases and other enzymes. Metabolites of I were observed in the digestive systems and coxal muscles. After topically applied I has penetrated into the body of the cockroach, it may be transported to the tissues by the blood. (From BA 35: 1960, 9633).

II-G-1-g DIAZINON

631 Forgash, A.J., Cook, B.J., Riley, R.C. MECHANISMS OF RESISTANCE IN DIAZINON-SELECTED MULTI-RESISTANT Musca domestica. J. econ. Ent. 55, 4 (1962) 544-51.

Studies were made in 3 strains (a susceptible, a low-resistant, and a high-resistant) of house flies (Musca domestica L.) to determine whether resistance to diazinon$^{(R)}$ (0,0-diethyl 0-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate), parathion and DDT is attributable to differences in absorption rates. P^{32}-labelled diazinon was used. Processing of samples for P^{32}-counting (extraction, concentration of extracts and counting itself) are described. Penetration studies with diazinon showed less rapid absorption by resistant flies and it was concluded that reduction in permeability of the cuticle is a factor in resistance to diazinon. This is not the only defense mechanism, however, since flies which were 125-fold resistant by topical measurement still showed some tolerance (14-fold) when the insecticide was injected. Similarly, the low-resistant strain (15-fold topically) was 3-fold resistant to injected diazinon. More rapid detoxication is precluded as the additional resistance mechanism, since the susceptibles contained higher amounts of water-soluble metabolites than resistant flies. Resistance to diazinon was higher by oral application than by either injection or topical treatment. Ali-esterase activity of the strains was inversely proportional to the level of diazinon resistance; this fact confirms previous reports on other o-p resistant house flies. There were only slight differences among the strains in cholinesterase level and in sensitivity to in vitro inhibition. In parathion and DDT-resistance, penetration appears not to be an important factor.

II-G-1-h DIMETHOATE

632 Bull, D.L., Lindquist, D.A., Hacskaylo, J. ABSORPTION AND METABOLISM OF DIMETHOATE(*) IN THE BOLLWORM AND BOLL WEEVIL. J. econ. Ent. 56, 2 (1963) 129-34.

P^{32}-labelled dimethoate (*) was absorbed and excreted rapidly by 5th instar bollworm larvae (Heliothis zea (Boddie)) and adult boll weevils (Anthonomus grandis Boheman). These insects absorbed 54.2% and 74.5% of topically applied dimethoate, respectively, after 24 h and 76.2% of an injected dose of dimethoate was excreted by bollworm larvae after 24 h. The in vivo metabolism of P^{32}-labelled dimethoate in adult boll weevils, 5th-instar bollworm larvae, and cotton seedlings was characterized qualitatively and quantitatively through the use of paper chromatography, autoradiography, and standard radioassay procedures. Dimethoate and 11 metabolites were detected in various insect and plant extracts. In bollworms, the principal sites for hydrolytic cleavage of the dimethoate molecule were the carbonyl-nitrogen bond and the sulfur-carbon bond. The oxygen analogue of dimethoate was formed in both plants and insects but was broken down rapidly by the latter to non-toxic products. (Auth.)

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* O,O-dimethyl S-(N-methylcarbamoylmethyl)phosphorodithioate.

II-G-1-j IMIDAN

633 Menn, J.J., McBain, J.B. METABOLISM OF IMIDAN IN INSECTS. (Abstr. 50). Bull. ent. Soc. Amer. 9, 3 (1963) 163.

The metabolic fate of C^{14}-Imidan [phthalimidomethyl-O,O-dimethyl-phosphorodithioate] was studied in insects in vivo. Purified acetone extracts of whole insect homogenates were examined by means of paper chromatographic and radiotracer techniques. Results were correlated with the metabolic fate of Imidan in plants.

II-G-1-k IRIDOMYRMECIN

634 Korte, F., Schreiber, H.J. INSEKTIZIDE IM STOFFWECHSEL. IV. IRIDOMYRMECIN-(3-^{14}C). (Insecticides in metabolism. IV. Iridomyrmecin-(3-C^{14})). Liebigs Ann. 656 (1962) 145-8. (In German).

A method for microsynthesizing C^{14}-labelled iridomyrmecin is described, starting with $BaC^{14}O_3$ (specific activity 23.5 mc/mM). The insecticide is broken down into the corresponding δ-hydroxy-carboxylic acids by freshly ground beef liver and Aëdes aegypti larvae (5-d-old larvae were left for 20 h, such that 20 cc water were and 200 γ-iridomyrmecin were allowed per 5 g larvae). Of the enzymes testes (catalase, peroxidase, glucose oxidase, α-chymotrypsin, and a mixture of hydrolases from Aspergillus oryzae) none appeared to have any effect on the insecticide.

II-G-1-l NAPHTHALENE

635 Arias, R.O. THE IN VIVO HYDROXYLATION OF NAPHTHALENE-1-C^{14} BY HOUSEFLY MICROSOMES. Diss. Abstr. 24, 5 (1963) 1817-8.

Naphthalene-1-C^{14} was utilized for establishing the optimum conditions for the hydroxylation of aromatic hydrocarbons by microsomes isolated from Musca domestica L. Reduced triphosphopyridine appears to be essential for the hydroxylation reactions. A transitory metabolite, possibly an epoxide of naphthalene, does not require TPN. The increasing order of naphthalene metabolism by microsomes isolated from 6-d-old flies was, according to strain: susceptible, dieldrin-resistant, naphthalene-resistant, and DDT resistant. These differences were found to be insignificant among the first 3 strains when the microsomes were isolated from 12-d-old flies. Chromatographic evidence was presented with shows that the 4 strains produced the same 5 naphthalene metabolites when 6-d old, but only the susceptible strains exhibited this pattern when the flies were 12-d old. The oxidative mechanism of the microsomal system was inhibited by SKF 525-A and piperonyl butoxide. The soluble fraction has been shown to possess the necessary mechanism for the hydroxylation of naphthalene, however, the amount of substrate metabolized was less than with microsomal fractions. Chromatographic evidence indicated that 7 non-volatile metabolites were produced when naphthalene was the substrate and only 5 when 1-naphthol-1-C^{14} was used.

II-G-1-m MALATHION

636 Bigley, W.S., Plapp, F.W., Jr. METABOLISM OF MALATHION AND MALAOXEN BY THE MOSQUITO, Culex tarsalis Coq. J. Insect Physiol. 8, 9/10 (1962) 545-57.

Radiometric and enzymatic techniques were used in studying the metabolism of malathion and malaoxon by susceptible and malathion-resistant Culex tarsalis Coq. larvae. Radiometric studies showed malathion-resistant larvae were 2 to 11 times more efficient in degrading malathion than susceptible larvae, both in vivo and in vitro. Malathion was degraded primarily by the formation of carboxylic acid derivatives in larvae of both colonies. In vitro studies showed resistant larval homogenates produced over 11 times more carboxyesterase derivatives than phosphatase derivatives as compared with a 2:1 ratio in susceptible larvae. Enzymatic studies indicated that the relatively small fraction of total malathion converted to malaoxon was detoxified at a much more rapid rate in larvae of the resistant than in larvae of a susceptible strain. The differences noted are of sufficient magnitude to be considered primary factors responsible for the resistance to malathion present. (Auth.)

637 Bigley, W.S., Plapp, F.W., Jr. METABOLISM OF MALATHION IN SUSCEPTIBLE AND RESISTANT HOUSE FLIES. (Abstr. 246). Bull ent. Soc. Amer. 9, 3 (1963) 172.

Degradation of C^{14} malathion was rapid in both susceptible and malathion-resistant housefly strains. The resistant strain degraded the compound at a rate several times greater than did susceptible flies. The malathion synergist DEF greatly decreased the rate of malathion degradation.

638* Matsumura, F. THE PERMEABILITY OF INSECT CUTICLE. M.S. Thesis, University of Alberta, Canada 1959.

639 Matsumura, F., Brown, A.W.A. BIOCHEMISTRY OF MALATHION RESISTANCE IN Culex tarsalis. J. econ. Ent. 54, 6 (1961) 1176-85.

Radioactive malathion was synthesized from P^{32}-phosphoric acid (see J. econ. Ent. 52 (1961) 1063) and purified. Larvae of the resistant strain of Culex tarsalis Coquillett, on exposure to malathion, come to contain $\frac{1}{3}$ as much malaoxon as normal larvae. This is partly due to a higher phosphatase activity hydrolyzing malaoxon. But the major difference is in the higher carboxyesterase activity hydrolyzing malathion; this interstrain difference was demonstrated in vivo in larvae cleared of gut contents, and in vitro in homogenates and particularly the mitochondrial fraction. EPN, a carboxyesterase inhibitor, proved synergistic for malathion against the resistant strain. Increased carboxyesterase content was inseparable genetically from malathion resistance in hybridization experiments, which also indicated the malathion resistance to be due to a single partially dominant gene allele.

640 Matsumura, F., Brown, A.W.A. BIOCHEMICAL STUDY OF A MALATHION-TOLERANT STRAIN OF Aedes aegypti. Mosquito News 21 (1961) 192-4.

Larvae of a malathion-tolerant strain Aëdes aegypti did not differ from the normal in the activity of phosphatase, carboxyesterase, or aliesterase. Experiments with P^{32}-labelled malathion showed 1/12 as much absorption and retention of malathion as in larvae of the normal strain. The high cross-resistance shown by this strain to DDT was accompanied by only 1/4 as much absorption and retention of DDT as normal. C^{14}-labelled DDT was used (1 ppm).

641 Mengle, D.C., Lewallen, L.L. HISTOCHEMISTRY OF MALATHION RESISTANCE IN THE ENCEPHALITIS MOSQUITO, Culex tarsalis Coq. (Abstr.55). Bull. ent. Soc. Amer. 8, 3 (1962) 155.

Using histochemical and radioautographic techniques the metabolism and mode of action of malathion was investigated in resistant and susceptible strains of the mosquito, Culex tarsalis Coq. Relationships between the results of these experiments and levels of resistance will be discussed. (Auth.)

642 Mengle, D.C., Lewallen, L.L. METABOLISM OF MALATHION BY A RESISTANT AND A SUSCEPTIBLE STRAIN OF Culex tarsalis: I. DEGRADATION IN VIVO AND IDENTIFICATION OF ORGANIC SOLUBLE METABOLITES. Mosquito News 23, 3 (1963) 226-33.

Larvae of a resistant and a susceptible strain were treated with a discriminating dose of P^{32}-labelled malathion. The larvae were homogenized at various times, up to 24 h, extracted, and the insecticide metabolites identified qualitatively and quantitatively by column and paper chromatography. At the time the water-soluble metabolites were considered as a single group; the chloroform-soluble constituents were further identified as the original malathion and its toxic oxidation product, malaoxon. A similar rate of penetration of malathion into both strains is implied, with similar rates of conversion of malathion to malaoxon, and similar degradation of malathion. Hydrolysis of malaoxon however, occurred at twice the rate in the resistant strain as in the susceptible strain. Malaoxon concentrations were found to be not similar in the 2 strains at the time of similar symptoms (LT_{50}). Homogenizing the larvae may have masked the concentration at a vital locus.

II-G-1-n PARATHION AND METHYL PARATHION

643 Fukami, J., Shishido, T. SELECTIVE TOXICITIES OF ORGANIC PHOSPHORUS INSECTICIDES. III. AN ENZYME SYSTEM INCLUDED IN THE CLEAVAGE OF METHYL PARATHION TO DEMETHYL PARATHION IN THE SUPERNATANT OF SOME TYPES OF HOMOGENATES. Botyu-Kagaku 28, 3 (1963) 77-81.

The nature of the reaction system from methyl parathion to demethyl parathion was studied in tissues of mammals (rat, guinea pig, and rabbit) and insects (Chilo suppressalis, Periplaneta americana, and Xylotrupes dichotomus), using P^{32}-labelled methyl parathion and Me paraoxon. The reaction in the supernatant from rat-liver homogenate was independent of the presence of coenzyme II and was inhibited most effectively by phenylmercury acetate and p-chloromercuribenzoate. The optimal pH was 8.5-9.5. Addition of reduced glutathione restored the activity. Anaerobic conditions did not affect the reaction. These results suggested that the reaction requires the presence of a SH-containing enzyme. The highest activity was found in the liver among the organs tested, whatever the species. There was no activity in the blood of larvae of C. suppressalis or X. dichotomus. (CA 60: 1964, 15078cd)

644 O'Brien, R.D., Smith, E.H. THE UPTAKE AND METABOLISM OF PARATHION BY INSECT EGGS. J. econ. Ent. 54, 1 (1961) 187-91.

In an attempt to account for their widely differing susceptibilities to parathion, the uptake and metabolism of P^{32}-parathion vapor by eggs of the large milkweed bug (Oncopeltus fasciatus (Dall.)) and peach tree borer (Sanninoidea exitiosa (Say)) and the uptake by eggs of the Mexican bean beetle (Epilachna varivestis Muls.) and southern armyworm (Prodenia eridania (Cram.)) were investigated. In all cases large amounts of parathion were taken up by the chorion and most (50% to 94%) could be washed off with acetone followed by chloroform. Considerable variations were found in ability of the eggs to take up parathion and in penetration of the chorion by the parathion. In the ovicidally susceptible peach tree borer and the non-susceptible milkweed bug conversion of internal parathion to paraoxon was 30% and 25%, respectively, suggesting that activation and detoxification did not account for the insensitivity of the milkweed bug. In the other three species there was within broad limits a general relationship between internal levels of parathion and ovicidal susceptibility. No single factor could be cited to account for the variations in ovicidal susceptibility of the various species to parathion. (Auth.)

645 Plapp, F.W., Jr., Darrow, D.I., Bigley, W.S., Eddy, G.W. STUDIES ON PARATHION METABOLISM IN NORMAL AND PARATHION-RESISTANT HOUSE FLIES. J. econ. Ent. 54, 2 (1961) 389-92.

The absorption, detoxication, and excretion of (P^{32}-labelled) parathion and para-oxon were studied in susceptible and parathion-resistant strains of Musca domestica L. by radiometric techniques. No differences in the rate of absorption of the toxicants were noted between susceptible and resistant flies. Both insecticides were rapidly detoxified by the flies in vivo, the metabolism being more rapid in the resistant strain. Differences in the rate of excretion of parathion and/or its metabolites were not great, but para-oxon and/or its metabolites were excreted much more rapidly by flies of the resistant strain. (From auth.)

646 Schmidt, C.H., Weidhaas, D.E. THE TOXICOLOGICAL ACTION OF THREE ORGANOPHOSPHORUS INSECTICIDES WITH THREE SPECIES OF MOSQUITO LARVAE. J. econ. Ent. 54, 3 (1961) 583-6.

Toxicological studies were undertaken with radioactive-labelled parathion, Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate), and dimethoate to determine the dosage of these toxicants absorbed by larvae of Anopheles quadrimaculatus Say, Aedes aegypti (L.), Aedes taeniorhynchus (Wied.) The interrelationship of the dosage absorbed, the concentration, the time of exposure, and the mortality were also determined. Results indicated that the efficiency of uptake differed with the insecticide used. The concentration required to kill larvae did not necessarily reflect the amount of insecticide that entered the insect. For example, dimethoate in 24-h exposure tests gave an LC_{50} of 4.0 ppm and an LD_{50} of 0.0040 µg/larva; whereas Bayer 22408 gave an LC_{50} of 0.009 ppm and an LD_{50} of 0.0020 µg/larva. The amount of insecticide found in larvae after 24 h of exposure at the LC_{50} concentration was only a very small percentage of the total to which they were exposed: with dimethoate, 0.02%; with parathion, 0.7%; and with Bayer 22408, 2.2%. Better methods of treatment could make some inferior toxicants into effective larvicides and should increase the efficiency of all toxicants. All three insecticides were excreted readily by larvae. (Auth.)

II-G-1-o R 6700

647* Becker, H., Müller, P., Forster, H. ABSCHLUSSBERICHT ÜBER EINE UNTERSUCHUNG ZUR AUFKLÄRUNG DES INSEKTENSTOFFWECHSELS EINES ZUM PATENT ANGEMELDETEN INSEKTIZIDS (R 6700) DURCH MARKIERUNG MIT RADIOAKTIVEN ISOTOPEN FÜR DIE FIRMA RUHRCHEMIE AG., OBERHAUSEN-HOLTEN. (Final report on an investigation into the metabolism of insecticide R 6700, patent applied for, carried out for the firm Ruhrchemie AG., Oberhausen-Holten, by means of radioisotopes). Battelle Institut e.V., Frankfurt am Main. 9 May 1956, 16p. (In German).

Neutron-irradiated chloroform was mixed with 400 cc of 1% NH_4OH, and the Cl^{38} ions resulting from the irradiation separated out. A carrier substance in the form of NaCl was added, and on acidifying with HNO_3 it was possible to precipitate Cl^{38} together with the excess of $AgNO_3$ solution as $AgCl^{38}$. Contamination with radioactive phosphorus was avoided. Further steps in the synthesis of Cl^{38}-labelled R 6700 are described, together with the apparatus used. Shortage of time did not permit any precise determination of yield. Fly assays were carried out with Cl^{38}-R 6700 dissolved in CCl_4, subsequently evaporated. Flies were not given any water or sugar for 2 h before the test, and were exposed to the insecticide for 40 min. Only 20% (3-4/20) flies were dead, the others were anaesthetized with CO_2 and analyzed. The technique is given. Discrepancies in distribution data (for head, legs, thorax, wings, and remainder) point to weaknesses in the procedure. The desirability of a series of tests with C^{14}-R 6700 is stressed, which would allow larger numbers of flies to be tested and also permit better differentiation between absorbed and externally adsorbed or contaminating material.

II-G-1-p RONNEL

648 Hopkins, T.L. FUNCTIONS OF THE MADEIRA COCKROACH (Leucophaea maderae) ALIMENTARY TRACT IN THE ABSORPTION, METABOLISM, AND EXCRETION OF RONNEL. J. econ. Ent. 54, 2 (1961) 224-30.

The role of the alimentary tract of the Madeira cockroach, Leucophaea moderae (F.), in the in vivo processes of absorption, transport, metabolism, and excretion of P^{32}-labelled (O,O-dimethyl O-(2,4,5-trichlorophenyl) phosphorothioate) was investigated together with the qualitative and quantitative nature of the phosphorus-containing metabolites eliminated. The wall of the foregut was found to be permeable to orally injected ronnel but not to certain of its water soluble hydrolysis products while the hindgut was permeable to both. The midgut primarily accumulated the water soluble metabolites when direct movement of ronnel from the foregut was blocked, and evidence suggests it as a site for hydrolytic degradation of the insecticide. More than 97% of the radioactivity accumulating in the hindgut was in the form of water-soluble degradation products with about 2/3 entering with the discharge of the malpighian tubules. Only small quantities of radioactivity passed directly from the mid- to the hindgut. Sublethal doses of ronnel progressively inhibited elimination of excreta while the hydrolysis products had little effect. The major metabolite of ronnel eliminated in the faeces was identified as dimethyl thiophosphate. This compound gradually diminished with time while the minor metabolites dimethyl phosphate and monomethyl ronnel increased. (Auth.)

II-G-1-q RUELENE

649 Brady, U.E., Jr., Arthur, B.W. ABSORPTION AND METABOLISM OF RUELENE BY ARTHROPODS. J. econ. Ent. 55, 6 (1962) 833-6.

The absorption and metabolism of P^{32}-labeled Ruelene® (O-4-tert-butyl-2-chlorophenyl O-methyl methylphosphoramidate) was studied in 16 species of arthropods. The house fly, Musca domestica L.; stable fly, Stomoxys calcitrans (L.); yellow mealworm, Tenebrio molitor L.; and American cockroach, Periplaneta americana (L.), absorbed greater than 80% of the topically applied dose by 24 h after treatment, whereas the boll weevil, Anthonomus grandis Boheman; Gulf Coast tick, Amblyomma maculatum Koch; and brown dog tick, Rhipicephalus sanguineus (Latreille), absorbed less than 25% of the applied dose. The following insects were also tested: horn fly, Haematobia irritans (L.), German cockroach, Blattella germanica (L.), imported cabbageworm, Pieris rapae (L.), larva; cabbage webworm, Hellula rogatalis (Hulst), larva; tobacco budworm, Heliothis virescens (F.), larva; corn earworm, Heliothis zea (Boddie), larva; rice weevil, Sitophilus oryzae (L.), adult; cadelle, Tenebroides mauritanicus (L.) Mexican bean beetle, Epilachna varivestis Mulsant, adult; bed bug, Cimex lectularius L., adult; cotton stainer, Dysdercus suturellus (Herrich-Schäffer), adult; and honey bee, Apis mellifera L. In general, adult Diptera degraded Ruelene more completely than Lepidoptera larvae, adult Coleoptera, or adult Hemiptera. Most of the radioactivity in the acetone extract of insects had the same R_f as Ruelene. The metabolism of Ruelene by insects and ticks was less complex than in mammals. Selectivity was probably a function of absorption and detoxification rates in naturally tolerant and in susceptible arthropod species.

II-G-1-r SCHRADAN

650* Saito, T. DISTRIBUTION OF P^{32}-LABELLED SCHRADAN IN THE AMERICAN COCKROACH [Periplaneta americana (L.)]. Botyu-Kagaku 25, 2 (1960) 57-64. (In Japanese, with English summary).

651* Saito, T. DISTRIBUTION OF P^{32}-LABELLED SCHRADAN IN VARIOUS INSECTS [Periplaneta americana (L.), Musca domestica L., Chilo suppressalis (Wlk.), Nephotettix cincticeps (Uhl.), Scotinophara lurida (Burm.) AND Leptocorisa varicornis (F.)]. Botyu-Kagaku 25, 2 (1960) 64-71. (In Japanese, with English summary).

See 652.

652 Saito, T. STUDIES ON THE SELECTIVE TOXICITY OF SCHRADAN. p.255-65 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Schradan has low toxicity for chewing insects (Chilo suppressalis Walker larvae, Periplaneta americana L. adults, Musca domestica vicina Macq. adults) whilst being highly toxic to sucking insects (adults of Leptocorisa varicornis Fabricius, Scotinophara lurida Burmeister, Nephotettix bipunctatus cincticeps Uhler). The absorption, excretion and metabolic rates of P^{32}-schradan in those insects varied considerably. No definite relationships were found between those factors and toxicities, nor between susceptibility of cholinesterases to toxicants and toxicities, but quantitative differences in P^{32}-schradan distribution patterns were found. Much more P^{32}-schradan accumulated in the central nervous systems of sucking insects than in those of chewing insects. Electron microscope observations on the central nervous sheath disclosed that the thoracic ganglia of chewing insects were enclosed in a thick and robust sheath, while those of sucking insects were surrounded by simple, thin double membranes. The selective toxicity of schradan was interpreted to be due to differences in schradan-distribution patterns in insect bodies. The distribution of toxicants in insects and the character of the nerve sheath, which acts as a barrier against the penetration of toxicants, may be the most important factors responsible for the selective toxicity observed.

II-G-1-s TELODRIN

653 Cox, H.C., Bowman, M.C. UPTAKE OF TELODRIN BY FALL ARMYWORM LARVAE EXPOSED TO RESIDUES. (Abstr.53). Bull. ent. Soc. Amer. 9, 3 (1963) 163.

Following exposure, different instars were analyzed by gas-liquid chromatography and by paper chromatography of C^{14}-labelled Telodrin. Data were obtained on toxicant content in the integument and internal organs and lipid content of full-grown larvae.

654 Hamilton, E.W. METABOLISM OF ALDRIN AND DIELDRIN BY THE AMERICAN COCKROACH, Periplaneta americana (L.). Diss. Abstr. 22, 2 (1961) 417.

Data on the conversion of aldrin to dieldrin and other aldrin metabolites, in vivo, and the effect of selected nucleotides and an enzyme, peroxidase (horseradish), on the epoxidation of aldrin, in vitro, were obtained. Two metabolites of aldrin were detected in the roach extracts: dieldrin and a ketone (metabolite K). Provisional identification of metabolite K (as extracted from sections of paper chromatograms containing the material) with a pure, synthesized dieldrin ketone was shown by a common band of absorbance at 5.72 μ on their infrared spectra. Cyclopentane, a 5-carbon ring ketone, shows the same band of absorbance. The difference in R_f values for metabolite K and dieldrin, however, pointed to a possible difference in the number and placement of the chlorine atoms. The formation of an inorganic chloride is indicated by apparent dechlorination of aldrin and its metabolites in the roach (as shown by difference in conversion detected with C^{14}- and with Cl^{36}-labelled aldrin); the presence of a product III in Cl^{36}-labelled aldrin standard solution, and its absence in C^{14}-labelled aldrin standard solutions; and the formation of significant amounts of III in peroxidase and/or DPN^+ incubation mixtures containing Cl^{36}-labelled aldrin, but not in mixtures containing C^{14}-labelled aldrin. The methylene bridge chlorines are especially labile. Therefore, the methylene bridge could be one of the reactive sites on the aldrin, dieldrin, or dieldrin ketone molecule. Another reactive site is the double bond where the epoxide or ketone is formed. The in vitro data showed that incubation mixtures containing peroxidases and/or DPN^+, roach digestive tract, and aldrin resulted in the conversion of significant amounts of aldrin to dieldrin.

655 Korte, F., Stiasni, M. INSEKTIZIDE IM STOFFWECHSEL. III. MIKROSYNTHESE VON ^{14}C-MARKIERTEM TELODRIN. (Insecticides in metabolism. III. Microsynthesis of C^{14}-labelled Telodrin). Liebigs Ann. 656 (1962) 140-4. (In German).

Two microsyntheses of C^{14}-labelled Telodrin (insecticide R 6700) (exo-cis-1,3-endo-4,5,6,7,10,10-octachloro-4,7-endomethylene-4,7,8,9-tetrahydrophthalan) are described in detail. Starting with $BaC^{14}O_3$ (specific activity 10.8 mc/mM), the total yield was 21% when the terahydrofurane ring was labelled, or 60% relative to the labelled hexachlorocyclopentadiene when the chlorinated ring was marked; details are given in CA 58: 1963, 6777e. Larvae of Aëdes aegypti absorbed Telodrin-3-C^{14} only very slightly; at a concentration of 10 ppm I-3-C^{14} was absorbed to an extent of 1% and converted to 60% VIII (see CA).

II-G-1-t THIODAN

656 Barnes, W.W. THE PENETRATION AND METABOLISM OF THIODAN IN M. domestica. (Abstr.49). Bull. ent. Soc. Amer. 9, 3 (1963) 163.

Female M. domestica of resistant and susceptible strains were treated topically with C^{14}-tagged Thiodan. Rate of penetration and metabolic fate of the insecticide was determined via gas and paper chromatography and autoradiograms. The results indicate varied isomeric penetration and metabolism.

See also:

63 Some results of the use of tracer techniques in the study of plant protection. (Andreev et al., 1958)
207 A new DDT-metabolizing enzyme in the German cockroach. (Agosin et al., 1961)
303 Radiometric assay of acetylcholinesterase. (Winteringham and Disney, 1962)
304 Acetylcholinesterase activity and competitive inhibition at low substrate concentrations. (Winteringham and Disney, 1963)
380 Lipids of DDT-resistant and susceptible larvae of Aedes aegypti. (Fast and Brown, 1962)

412 Radioactive tracer techniques in insect biochemistry. (Winteringham, 1962)

428 The relation between physical properties and penetration of solutes into cockroach cuticle. (Olson and O'Brien, 1963)

500 A new bioassay technique, with special reference to the specific bioassay of DDVP insecticide. (Sun and Johnson, 1963)

506 The action of fumigants on insects. II. The effect of hydrogen cyanide on the activity and respiration of certain insects. (Bond, 1961)

515 The metabolism of naphthalene by house fly microsomes and its inhibition by insecticide synergists. (Schonbrod and Terriere, 1962)

517 Drywood termite metabolism of Vikane fumigant as shown by labeled pool technique. (Meikle *et al.*, 1963)

521 Physiology and biochemistry of resistance to chlorinated hydrocarbons. (Hoskins, 1962)

525 Insecticides in metabolism. II. Metabolism of C^{14}-labelled aldrin and C^{14}-labelled dieldrin in microorganisms, liver homogenates and mosquito larvae. (Korte *et al.*, 1962)

526 Syntheses and studies on some C^{14}-labelled insecticides belonging to the halogenated hydrocarbons and on labelled Iridomyrmecin. (Korte *et al.*, 1962)

528 Pick-up and penetration of dieldrin from residual films. (Potter, 1961)

529 Microsyntheses of C^{14}-labelled insecticides and some biochemical studies. (Rechmeier, 1962)

531 Relations between structure, metabolism and toxicity of the 'cyclodiene' insecticides. (Brooks and Harrison, 1963)

534 Penetration of BHC isomers through cuticle of the American cockroaches. (Fukami *et al.*, 1961)

542 Fate of S^{35}-labeled *p*-chlorophenyl *p*-chlorobenzenesulfonate in some organisms. (Tomizawa, 1960)

544 The metabolism of C^{14}-labeled DDT in the larvae, pupae, and adults of *Drosophila melanogaster*. (Menzel *et al.*, 1961)

548 Further investigations into the mechanism of action of the insecticide Thiodan$^{(R)}$. (Gösswald, 1962)

549 Problems of application and action of Thiodan studied with S^{35}-labelled insecticide. (Gösswald *et al.*, 1963)

556 Biological and chemical properties of dimethoate and related derivatives. (Brady and Arthur, 1963)

557 Reaction of certain phosphorothionate insecticides with alcohols and potentiation by breakdown products. (Casida and Sanderson, 1963)

561 Experiments on the control of some species of plant coccids. (Pietri-Tonelli *et al.*, 1961)

568 Metabolism of Famophos in mammals and insects. (Sferra, 1962)

571 Distribution of aerially applied malathion-S^{35} in a forest ecosystem. (Giles and Peterle, 1963)

572 The effect of SKF 525A (2-diethylaminoethyl 2:2-diphenylvalerate hydrochloride) on organophosphate metabolism in insects and mammals. (O'Brien, 1961)

582 Studies on the quantitative uptake of P^{32}-labelled schradan by adults of *Dysdercus koenigii* Fabricius from insecticidal films. (Rattan Lal *et al.*, 1960)

584 Studies on the mode of action of organophosphorus compounds. Part I. Metabolic fate of P^{32}-labeled Sumithion and methyl parathion in guinea pig and white rat. (Miyamoto *et al.*, 1963)

584 Studies on the mode of action of organophosphorus compounds. Part I. Metabolic fate of P^{32}-labeled Sumithion and methyl parathion in guinea pig and white rat. (Miyamoto *et al.*, 1963)

586 Systemic action of two insecticides on arthropod parasites of rabbits and cattle. (Adkins, 1961)

596 Penetration of pyrethrin I labelled with carbon-14 into susceptible and pyrethroid resistant houseflies. (Fine *et al.*, 1963)

609 Non-hydrolytic pathway in metabolism of Sevin. (Dorough and Casida, 1963)

610 Non-hydrolytic pathway in metabolism of *N*-methylcarbamate insecticide. (Dorough, 1963)

611 Relation of the rate of penetration and metabolism to the toxicity of Sevin to three insect species. (Eldefrawi and Hoskins, 1961)

643 Selective toxicities of organic phosphorus insecticides. III. An enzyme system included in the cleavage of methyl parathion to demethyl parathion in the supernatant of some types of homogenates. (Fukami and Shishido, 1963)

661 Metabolism of *O*,*O*-dimethyl *O*-[4-(methylthio)-*m*-tolyl] phosphorothioate by white rats. (Brady and Arthur, 1961)

662 Absorption and metabolism of Bayer 22408 by dairy cows and residues in the milk. (Buttram and Arthur, 1961)

681 The relation between toxicity and metabolism of paraoxon in the frog, mouse and cockroach. (Potter and O'Brien, 1963)

686 Studies on the translocation of radioactive schradan in plants and its uptake from film by insects. (Chatterji *et al.*, 1961)

1555 Some applications of radioisotopes to the study of the contamination of insects by insecticide solutions. (Lewis, 1963)

II-G-2 INSECTICIDE METABOLISM IN ANIMALS OTHER THAN INSECTS

II-G-2-a GENERAL

657 Arthur, B.W. METABOLISM OF SYSTEMIC AND OTHER RECENT INSECTICIDES IN ANIMALS. p.65-81 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Review article, with 103 references. Typical biochemical mechanisms are discussed, with specific systemic and non-systemic organophosphate insecticides as illustrations. Organophosphates undergo several activation and detoxication processes in insects and mammals. Detoxication mechanisms of organophosphates include destructive hydrolysis at the P-O-C, P-S-C, P-C, P-N, or P-O-N bonds. Other hydrolytic processes occur at groups not linked to the phosphorus atom. It is stressed that insecticide metabolism studies are basic in understanding the selective toxicity of insecticides, resistance mechanisms, residue problems, and mode-of-action concepts.

658 Филатов, Г.В., Карташов, П.А., Мутин, М.И., Закамырдин, И.А., Узаков, У.Я. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ В ИЗУЧЕНИИ ПРОЦЕССОВ ВСАСЫВАНИЯ, РАСПРЕДЕЛЕНИЯ И ВЫДЕЛЕНИЯ ИЗ ЖИВОТНОГО ОРГАНИЗМА НЕКОТОРЫХ ИНСЕКТИЦИДОВ. Стр. 249-53 в сб. "Применение радиации и радиоизотопов в борьбе с насекомыми-сельскохозяйственными вредителями. Труды Симпозиума, Афины, 22-26 апреля, 1963". Вена, Международное агентство по атомной энергии. 1963.

Filatov, G.V., Kartashov, P.A., Mutin, M.I., Zakamyrdin, I.A., Uzakov, U. Ya. USE OF RADIOISOTOPES IN STUDYING THE ABSORPTION, DISTRIBUTION AND ELIMINATION OF CERTAIN INSECTICIDES IN ANIMALS. p.249-53 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

The paper gives details on the rate at which DDT-C^{14}, polychloropinene-Cl^{36} and chlorophos-P^{32} are absorbed through the skin, accumulated in the organs and tissues and eliminated from the organisms of farm and laboratory animals. Under the experimental conditions described, the DDT retained by the (cow) organism 5 months after spraying was deposited in all organs, and primarily in fatty tissue. Polychloropinene undergoes rapid decomposition and is eliminated in the form of decomposition products. A P^{32}-labelled methyl chlorophos preparation of specific activity 250 mc was also used. When applied externally, chlorophos was detected in the blood within minutes (maximum after 30 min). By the 6th and 7th day, none could be detected in milk. After *per os* administration of chlorophos to rabbits chlorophos could be identified in urine and liver extracts.

659 Weidhaas, D.E., Schmidt, C.H., Chamberlain, W.F. METABOLISM OF RADIO-LABELLED SYSTEMIC INSECTICIDES IN ANIMALS. p.93-7 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

A summary is presented of research work on the metabolism of radio-labelled systemic insecticides in animals, with details on experimental procedures and important results. Analyses of samples of blood, urine, feces, meat, and milk are made by various methods in order to trace the fate of an insecticide or its associate residues in an animal. Results are cited for numerous insecticides. Studies are also included in which radioisotopes are used to aid research on the mode of action of insecticides and repellents, metabolism of insect repellents, and insecticide resistance problems. (Auth.)

II-G-2-b ALDRIN AND DIELDRIN

660 Kochen, W. UNTERSUCHUNGEN ÜBER DEN STOFFWECHSEL DES ALDRIN-C^{14} IN RATTEN AND KANINCHEN. [ISOLIERUNG VON METABOLITEN]. (Studies on the metabolism of aldrin-C^{14} in rats and rabbits. [Isolation of metabolites]). Diplomarbeit. Bonn. Universität. Institut für Chemie. 1963. 69p. (In German).

Following intravenous injection of aldrin-C^{14} and dieldrin-C^{14}, large quantities of a hydrophilic metabolite could be traced in the excrements. By paper chromatography this metabolite was separated into 2 components. The distribution, elimination and metabolism of aldrin-C^{14} were determined for the rat as follows:

(1) In the organs studied (brain, heart, spleen, testis, kidney, lung and blood) 0.08-0.60% of the injected dose could be recovered, with dieldrin contributing 60-90%. The hydrophilic product occurred in all the organs (lung 35%, kidney 52%, rather less in the rest). Aldrin was found in small quantities in all organs (excepting brain and duodenum). (2) Within 48 h, > 18% of the injected dose were excreted, metabolism to the hydrophilic product accounting for up to 95%. (3) Only ~20% of the injected doses was stored in fat. Although dieldrin is predominant, the hydrophilic product occurs also in abdominal fat. When dieldrin-C^{14} is injected intravenously, the same hydrophilic product can be separated as after aldrin-C^{14}. Experiments in vitro have shown that blood and duodenal secretion are capable of converting 3-5% of aldrin to dieldrin whereas the dieldrin itself undergoes no change. In rat, ~55% of the injected aldrin-C^{14} is eliminated in the faeces within 3 weeks. The hydrophilic product was also isolated from rabbit and separated into 2 components. One of these was identified, following hydrolysis, as the 6,7-diol of aldrin (1,2,3,4,10,10-hexachloro-6,7-dihydroxy-1,4-endo-5,8-exo-dimethano-1,4,4a,5,6,7,8,8a-octahydronaphthaline). The second predominant component was isolated as an oily, yellow product. The mole weight is between 438 and 444. Dieldrin was also isolated in crystalline form and identified.

II-G-2-c BAYER 29493

661 Brady, U.E., Jr., Arthur, B.W. METABOLISM OF O,O-DIMETHYL O-[4-(METHYLTHIO)-m-TOLYL] PHOSPHOROTHIOATE[*] BY WHITE RATS. J. econ. Ent. 54, 6 (1961) 1232-6.

The insecticide was labelled with P^{32}, O,O-dimethyl O-[4-(methylthio)-m-tolyl] phosphorothioate (Bayer 29493) was oxidized by rats at the phosphoryl sulfur and the thiophenyl group; the sulfoxide and sulfone derivatives of the parent material and its oxygen analogue were isolated and identified. Oxidation rather than isomerization was the predominant activation process. Hydrolysis occurred primarily at the P-O-phenyl bond; cleavage of the P-O-methyl bond was not demonstrated. The percentage of hydrolytic products in the urine decreased as the number of doses increased (10 mg/kg/day for 10 d). The cholinesterase of the blood and brain of rats was inhibited rapidly and recovered slowly. The acetonitrile-soluble residues in the liver, kidney, muscle, skin, and heart were negligible at 3 d following oral (100 mg/kg) or intraperitoneal treatment of rats. About 80% of the administered Bayer 29493 equivalents was eliminated in the excreta regardless of the route of administration. The absorption and stability of Bayer 29493 in the three species, Musca domestica, Blattella germanica and Anthonomus grandis, is tabulated. The non-hydrolyzed radioactive materials were largely unchanged Bayer 29493 but the insects were capable of oxidizing the thiophosphate and thiophenyl groups to form the 5 possible oxidation products of the parent material. The proportion of each oxidative metabolite was quite variable with the species. Metabolism in cotton plants was also investigated.

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[*] Bayer 29493

II-G-2-d BAYER 22408

662 Buttram, J.R., Arthur, B.W. ABSORPTION AND METABOLISM OF BAYER 22408 BY DAIRY COWS AND RESIDUES IN THE MILK. J. econ. Ent. 54, 3 (1961) 446-51.

P^{32}-labelled Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate) was applied dermally as a 0.5% emulsion to two Holstein dairy cows. Detectable quantities of the intact insecticide were isolated from the milk the first 6 days after treatment. Bayer 22408 equivalents in the milk were about 10 times higher than the actual Bayer 22408. No oxygen analog of the parent compound was isolated from milk, but it was the predominant nonhydrolyzed product of the feces. The faecal metabolites were toxic to stable fly (Stomoxys calcitrans (L.)) larvae, but not to house fly (Musca domestica L.) larvae. (Auth.)

663 Gattderdam, P.E., Chamberlain, W.F., Hopkins, D.E. STUDIES WITH P^{32}-LABELED BAYER 22408 IN STEERS AND GUINEA PIGS. J. econ. Ent. 55, 3 (1962) 326-32.

P^{32}-labelled Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate) was applied dermally and orally to steers at 12 mg/kg and subcutaneously to guinea pigs at levels of 95 and 117 mg/kg respectively. The compound was poorly absorbed through the skin following dermal treatment of a steer. In guinea pigs, Bayer 22408 was eliminated at a faster rate than in the orally treated steer, and the principal excretory route was through the urine rather than the faeces. In steers, the principal metabolite in the urine 2 d after treatment was diethyl phosphoric acid, whereas the main hydrolysis product in 2nd day samples after treatment of guinea pigs was diethylthiophosphoric acid. Of the total radioactivity in faeces from both steers and guinea pigs at 1 to 5 d post-treatment, significant portions were extractable into organic solvents. Chromatographic analysis of these extracts revealed that the major portion of Bayer 22408 was slowly converted to the oxygen analog, Bayer 25820 (O,O-diethyl O-naphthalimido phosphate). Bayer 22408 proved to be ineffective as a practical systemic against several important livestock pests, but information on its lack of absorption and stability as determined by the radioisotope technique aided in its further evaluation as a contact, residual insecticide. (From atuh.)

II-G-2-e BHC

664 Koransky, W., Portig, J., Muench, G. ABSORPTION, DISTRIBUTION, AND ELIMINATION OF α- AND γ-BENZENE HEXACHLORIDE. Arch. exp. Pathol. Pharmak. 244 (1963) 564-75.

The fate of Cl^{36}- or C^{14}-labelled α- (I) or γ-benzene hexachloride (II) after intraperitoneal administration to male albino rats at 40-200 mg/kg as a 2% solution in rape-seed oil, was studied after separation by ascending paper chromatography of extracts of the organs of sacrificed animals and of the excreta. About 35 and 90% of the II was absorbed by the body within 1 and 24 h, respectively. About 75% of the absorbed I and II were apparently uniformly distributed in fat depots, skin, and muscle lipids, in which they were stored unchanged. The residual I and II were present mainly in liver and in the digestive tract. Autoradiographic studies of microtome sections showed a high concentration of I-C^{14} in distinct regions of the central nervous system. Both isomers undergo dechlorination in vivo, and were converted to H_2O-soluble compounds excreted mainly by the kidneys. Small amounts of unchanged I, but none of the II were detected in faeces. About 95% of the activity was excreted in urine and faeces within 20 d; II was eliminated faster than I. The excretion of Cl^{36} was complete after 40 d. (CA 59: 1963, 9228g)

II-G-2-f CCl_4

665 Maling, H.M., Frank, A., Horning, M.G. EFFECT OF CARBON TETRACHLORIDE ON HEPATIC SYNTHESIS AND RELEASE OF TRIGLYCERIDES. Biochim. biophys. Acta 64 (1962) 540-5.

The effect of administering CCl_4 to rats on the incorporation of palmitate-1-C^{14} into liver and plasma lipids was determined. The CCl_4 caused a decrease in plasma triglyceride concentration. After palmitate-1-C^{14} was injected, labelled triglycerides appeared in the plasma in small amounts in treated rats compared to control animals. While in treated rats label was incorporated into liver triglycerides rapidly, in control rats there was a 10-20 min lag. Total radioactivity incorporated into liver triglycerides and phospholipids was greater in treated than in control rats. It is suggested that the increase in liver triglycerides caused by CCl_4 results from both increased hepatic synthesis and impaired release of triglycerides from liver to plasma. (CA 58: 1963, 3744a)

II-G-2-g Co-Ral

666 Krueger, H.R. METABOLISM AS FACTOR IN SELECTIVITY OF ORGANOPHOSPHATE INSECTICIDES. Diss. Abstr. 21 (1961) 2839-40.

P^{32}-labelled Bayer 21/199[*] (Co-Ral), applied dermally, was found in the urine with part of the excreted radioactivity partitioned with the lactone ring open and the rest of the molecule intact. The low toxicity of malathion to the German cockroach (as compared with the toxicity to the American cockroach and the housefly) is explained by low penetration through the cuticle. The metabolites of malathion found in insects and mice showed a predominance of phosphatase and carboxyesterase activity in insects and of the latter activity in mice. The low toxicity to mice is explained by the comparatively extensive degradation observed in mice. Similar differences in detoxification were found for other insecticides. The enzymic activities of insect homogenates were examined. (From J. Sci. Food Agric. 13, 5 (1962) i-173)

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[*] O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate.

II-G-2-h DDT

667 Holden, A.V. A STUDY OF THE ABSORPTION OF ^{14}C-LABELLED DDT FROM WATER BY FISH. Ann. appl. Biol. 50, 3 (1962) 467-77.

C^{14}-DDT absorbed by Salmo trutta from 0.5 and 0.1 ppm aqueous suspensions was found in all 14 organs and tissues examined, using a direct mount method on lipid extracts. The concentration in the gills was proportional to the aqueous concentration at death, but about 280 times greater. DDT in the gills, heart and liver was wholly or largely present in the blood in these organs. Storage occurred mainly in the stomach, pyloric caeca, intestine, spleen, muscle and skin, and possibly in the kidneys. Concentrations per unit weight of lipid showed more uniformity than per unit weight of tissue. Concentration in the lipids may determine toxicity to fish, explaining the greater susceptibility to DDT of fish in poor condition or of low fat content. Absorption from the water was very rapid, indicating that static water testing of insecticide toxicity to fish is unreliable. (Auth.)

668 Premdas, F.H., Anderson, J.M. UPTAKE AND DETOXIFICATION OF C^{14}-LABELED DDT IN ATLANTIC SALMON. J. Fish. Res. Bd Can. 20, 3 (1963) 827-37.

Salmo salar salar underyearlings were exposed to 1 ppm DDT-C^{14} and amounts of DDT adsorbed on external surfaces and absorbed internally were determined on the basis of C^{14} activity. Fish killed by exposure contained an average of 5.87 ppm DDT, of which approximately 67% was absorbed DDT. After a 5-min exposure, appreciable amounts were found throughout the body. High concentrations of DDT were found in the gills, liver, spleen, heart, kidney, gonads and swim bladder. Much smaller concentrations occurred in the stomach, intestines, brain, and spinal cord. The muscles, bone, and integument contained the least. It was concluded that DDT entered the body through the gills. Bioassays showed that an average of 67% of absorbed DDT was non-toxic to mosquito larvae. The adsorbed DDT showed little loss of toxicity. (CA 59: 1963, 10511f)

II-G-2-j DFP

669 Kurth, D., Athens, J.W., Cronkite, E.P., Cartwright, G.E., Wintrobe, M.M. LEUKOKINETIC STUDIES. V. UPTAKE OF TRITIATED DIISOPROPYL FLUOROPHOSPHATE (DFP) BY LEUKOCYTES. Proc. Soc. exp. Biol., N.Y. 107 (1961) 422-6.

When leukocytes from normal subjects and patients with leukemia were labelled with H^3-DFP in vitro, myelocytes labelled most intensely. Metamyelocytes and polymorphonuclear neutrophils contained about half as many labelled grains/cell as the myelocytes. Lymphocytes, eosinophils, and basophils did not bind significant amounts of H^3-DFP under the conditions of the experiment; a few monocytes were lightly labelled. Granulocytes in both blood and bone marrow were labelled after intravenous injection of H^3-DFP; the relative degree of labelling was: blood polymorphonuclear neutrophils 1.0, marrow polymorphonuclear neutrophils 0.3, marrow metamyelocytes 0.2, and marrow myelocytes 0.6. None of the other formed elements in either blood or bone marrow contained significant amounts of the label. (CA 55: 1961, 25042e) Also published as BNL-5442, Brookhaven National Lab., Upton, N.Y. 1960. 16p.

II-G-2-k DIAZINON

670 Kaplanis, J.N., Louloudes, S.J., Roan, C.C. THE DISTRIBUTION AND EXCRETION OF P^{32}-LABELED DIAZINON IN GUINEA PIGS. Trans. Kans. Acad. Sci. 65, 1 (1962) 70-5.

The distribution and elimination of P^{32}-labelled diazinon and/or metabolic products have been studied in guinea pigs following both oral and subcutaneous administration. The urine was the major route of elimination following administration by either method. The more rapid rate of excretion and the relative percentages of the dose in the urine and faeces following oral administration demonstrate that diazinon is efficiently absorbed from the digestive tract of the guinea pig. The accumulation of radioactive compounds in the caecum of the guinea pig following subcutaneous injection indicates that this tissue may play a role in metabolism or elimination of diazinon and/or its metabolites. (Auth. summary)

671 Millar, K.R. DETECTION AND DISTRIBUTION OF ^{32}P LABELLED DIAZINON IN DOG TISSUES AFTER ORAL ADMINISTRATION. N.Z. Vet. J. 11, 6 (1963) 141-4.

672 Williams, P.P., Robbins, J.D., Gutierrez, J., Davis, R.E. RUMEN BACTERIAL AND PROTOZOAL RESPONSES TO INSECTICIDE SUBSTRATES. Appl. Microbiol. 11, 6 (1963) 517-22.

Organophosphate insecticides, chlorinated hydrocarbons and carbamates were tested with bovine ruminal ingesta fractions from 10-month-old calves reared in isolation, and previously inoculated with single species of protozoa. Diazinon-C^{14} [O,O-diethyl-1-C^{14}-O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate] substrate uptake was demonstrated with suspensions of Entodinium simplex and Isotricha intestinalis. Rumen ciliates are suggested as a possible means of screening out useful insecticides susceptible to microbial dissimilation for use on forage and other cattle-feed crops.

II-G-2-l DIMETHOATE

673 Chamberlain, W.F., Hopkins, D.E., Gatterdam, P.E. THE METABOLISM OF P^{32}-LABELED DIMETHOATE IN SHEEP. J. econ. Ent. 54, 4 (1961) 733-40.

The metabolism and associated residues following intramuscular injection and oral feeding of 7 sheep were determined with P^{32}-labelled dimethoate. Degradation of dimethoate was rapid and almost quantitative for all sheep, and appeared not to be significantly affected by the route of administration. Only trace residues were found in tissues of sheep sacrificed 2 and 4 weeks post-treatment. Cleavage occurred at several sites on the dimethoate molecule, but to the greatest extent, initially, at the carbonyl-nitrogen bond. Evidence is presented for the occurrence of a previously unreported desalkyl derivative of dimethoate. (Auth.)

II-G-2-m DIPTEREX

674 Kühnert, M., Dedek, W., Schwarz, H. STUDIES ON INFLUENCING METABOLISM AND ON THE PRECIPITATION MECHANISM OF THE PHOSPHONIC ACID ESTER, TRICHLORPHON* IN THE COMMERCIAL PRODUCT "BUBULIN" WITH THE HELP OF ^{32}P-LABELLED PHOSPHOR IN THE INTRAVENOUS AND INTRAMUSCULAR INJECTION TO CATTLE. (B. Agr. 27: 1964, 102955). Arch. exp. VetMed. 17, 2 (1963) 403-17. (In German).

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* Dipterex

II-G-2-n GC 4072

675 Chamberlain, W.F., Hopkins, D.E. ABSORPTION AND ELIMINATION OF GENERAL CHEMICAL 4072 APPLIED DERMALLY TO CATTLE. J. econ. Ent. 55, 1 (1962) 86-8.

Studies were conducted on the absorption and elimination of P^{32}-labelled General Chemical 4072 (2-chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate) when sprayed on cattle at dosages equivalent to conventional 0.1%, 0.25%, and 0.5% sprays. The amount of radioactive material in the blood reached a maximum concentration 2 h after treatment, which indicated rapid absorption of the insecticide or its products by the skin of cattle. The elimination of the insecticide or its products was also rapid, as shown by the low concentrations in the urine and faeces 1 week after treatment. Urinary excretion accounted for 25% to 32% of the applied doses, whereas faecal elimination accounted for 1.6% to 2.1%. (Auth.)

II-G-2-o MALATHION

676 O'Brien, R.D., Niedermeier, R.P., Dauterman, W.C. THE METABOLISM OF ORALLY ADMINISTERED MALATHION* BY A LACTATING COW. J. agric. Food Chem. 9, 1 (1961) 39-42.

Malathion was rapidly excreted by a lactating cow, principally via the urine, which accounted for 90% of the excreted material. About 23% of the dose was not excreted over 3 weeks. As in non-ruminants, the major metabolite was produced by carboxyester hydrolysis; the principal faecal metabolite, however, was dimethyl phosphate. Milk contained no malathion or malaoxen, but had 0.11 ppm of radioactive materials, most of which could not be identified. Blood metabolites were also examined. P^{32}-labelled malathion was used. (Essentially auth.)

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* O,O-dimethyl S-1,2-bis(carboethoxy)ethyl phosphorodithioate

677 Peterle, T.J., Giles, R.H., Jr. NEW TRACER TECHNIQUES FOR EVALUATING THE EFFECTS OF AN INSECTICIDE ON THE ECOLOGY OF A FOREST FAUNA. Technical Progress Report No.1 Dec. 1, 1960 - Aug. 31, 1961. TID-13650, Ohio State Univ. Research Foundation, Columbus. 31 Aug. 1961. 22p.

The development of trapping techniques for sampling forest fauna populations is described. The methods used to prepare S^{35}-labelled malathion O,O-dimethyl S-(1,2-dicarboethoxyethyl) phosphorodithioate are discussed. Progress is reported on the project for evaluating the effects of malathion spraying on the ecology of a forest fauna. (NSA 15: 1961, 28910)

II-G-2-p PARATHION AND PARAOXON

678 Fredriksson, T., Bigelow, J.K. STUDIES ON THE PERCUTANEOUS ABSORPTION OF PARATHION AND PARA-OXON. II. DISTRIBUTION OF ^{32}P-LABELLED PARATHION WITHIN THE SKIN. Acta derm.-venereol., Stockh. 41 (1961) 344-52.

The distribution of P^{32}-labelled parathion within the skin following topical application for $\frac{1}{2}$, 1, 2, 4, and 24 h was studied in excised skin from man, rat, rabbit, and cat. Two different approaches were chosen: 1) (a) determination of radioactivity in 25 consecutive cellulose tape strips from the surface of human skin, (b) autoradiography of the same strips; and 2) autoradiography of skin sections with the use of 4 different techniques. Various factors influencing the autoradiograms were studied, special attention being paid to artefacts due to diffusion, type of radiation, and exposure time of the photosensitive material. It was found that parathion penetrates into hair follicles and sebaceous glands to some extent, but it was concluded that this is not necessarily the main route of absorption. There also was increasing activity below the epidermal layers, and transepidermal absorption is as likely.

679 Fredriksson, T., Bigelow, J.K. TISSUE DISTRIBUTION OF P^{32}-LABELED PARATHION. AUTORADIOGRAPHIC TECHNIQUE. Arch. envir. Hlth 2, 6 (1961) 663-7.

The tissue distribution of P^{32}-labelled Parathion (E 605, diethyl 4-nitrophenyl thionophosphate) has been investigated by means of an autoradiographic technique applied to sections of whole mice. The animals were injected subcutaneously and were killed at various intervals up to 4 h after injection. The material was absorbed very slowly from the subcutaneous deposit. The level of radioactivity in blood was low during the whole period of observation. However, the labelled material accumulated in various organs and tissues. The highest activity appeared in the salivary glands and cervical brown fat (hibernating gland). Liver, kidney, and adipose tissues showed high uptake of radioactivity, and fairly high activity was found in gastric and intestinal walls, thyroid, spleen, and lungs. Less activity was noted in the central nervous system, musculature, and bone marrow. The labelled material was mainly excreted by the kidneys and not in bile or via the intestinal mucosa. The results have been discussed with special regard to the formation of P^{32}-containing metabolites and breakdown products. The relationship between the distribution of the material and the sequence in which systemic symptoms appear in Parathion intoxications has been pointed out. The fact that the actual tissue distribution of a cholinesterase inhibitor need not necessarily follow the pattern indicated by the enzyme inhibition has been stressed. (Auth.)

680* Gar, K.A., Sazonova, N.A., Fadeev, Yu.N. PENETRATION AND METABOLISM OF TWO ORGANOPHOSPHORUS INSECTICIDES BY THE ORGANS OF WARM BLOODED ANIMALS. p.208-17 in "Trudy̆ Pervoĭ Vsesoyuznoĭ Nauchnoĭ Konferentsii po Gigiene, Toksikólogii i Klinikologii Novȳkh Insektofungitsidov, Kiev, 1957". 1959. (In Russian).

Estimations were made of the P^{32} in the blood and urine at intervals after introducing parathion (I) into the stomachs of rabbits (25 mg/kg) and cats (6 mg/kg). The concentration after 1 oral dose of metaphos* (75 mg/kg) was measured at times between 1 min and 15 d in the liver, kidney, brain, spinal cord, medulla oblongata, blood, and urine of female guinea pigs. The distribution of I was measured in the liver, kidney, brain, medulla oblongata, and thyroid of guinea pigs and rabbits. (CA 55: 1961, 19231).

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* Mixture of parathion and methyl parathion

681 Potter, J.L., O'Brien, R.D. THE RELATION BETWEEN TOXICITY AND METABOLISM OF PARAOXON IN THE FROG, MOUSE AND COCKROACH. Ent. exp. appl. 6, 4 (1963) 319-25.

Apparently high levels of paraoxon without increased toxicity in insects treated with parathion might be due to examination of the whole body and not the nervous system alone. Since paraoxon has been shown to be much less toxic to frogs and toads than to mice, tests were carried out in which paraoxon labelled with P^{32} was injected intraperitoneally into mice and frogs and intra-abdominally into females of Periplaneta americana (L.), after which the brains of the frogs and mice and the ventral nerve cords of the cockroaches were removed and the nervous tissues and remaining whole bodies homogenised for testing. Paraoxon was degraded extremely rapidly in the intact mouse and about half as fast in the frog and cockroach. At no time were the paraoxon levels in body and central nervous system substantially different. Paraoxon in vitro had relative potencies against nerve cholinesterase of mouse, frog and cockroach of 79:1:8. Its relative LD_{50}'s by injection were 3.3:73:1. It is concluded that the insensitivity of the frog is due to its insensitive cholinesterase and is unconnected with degradation rates.

II-G-2-q VAPONA

682 Casida, J.E., Niedermeier, R.P., McBride, L. METABOLISM OF 2,2-DICHLOROVINYL DIMETHYL PHOSPHATE IN RELATION TO RESIDUES IN MILK AND MAMMALIAN TISSUES. J. agric. Food Chem. 10, 5 (1962) 370-7.

The metabolism and residues of 2,2-dichlorovinyl dimethyl phosphate-P^{32} (DDVP or Vapona) were examined with rats, cows, and a goat. Studies with rats also utilized carbon labelled DDVP, dichloracetaldehyde, and dichloroethanol, and P^{32}-labelled O-methyl 2,2-dichlorovinyl phosphate and O,O-dimethyl phosphate. In addition, several rats and a single cow were treated orally with 1,2-dibromo-2,2-dichloroethyl dimethyl phosphate-P^{32} (Dibrom). These insecticides are rapidly hydrolyzed in mammals containing metabolites of DDVP, O,O-dimethyl phosphate and O-methyl 2,2-dichlorovinyl phosphate, are low in toxicity and rapidly excreted or further degraded. The 1-carbon of the 2,2-dichlorovinyl group in DDVP is excreted in urine predominantly as a conjugate of dichloroethanol, probably the glucuronide, in the faeces as unknown derivatives, and in the expired air as carbon dioxide. Small amounts of dichloroacetic acid may be formed, and some of the C^{14} persists in liver, blood, and other tissues in an unidentified form. Limited metabolism studies of DDVP in plants and of DDVP and Dibrom in bovine rumen fluid are also reported. (Auth.)

683 Hodgson, E., Casida, J.E. MAMMALIAN ENZYMES INVOLVED IN THE DEGRADATION OF 2,2-DICHLOROVINYL DIMETHYL PHOSPHATE (DDVP). J. agric. Food Chem. 10 (1962) 208-14.

The metabolic fate of DDVP by the action of mammalian enzymes is studied in vitro using C^{14}-labelled DDVP. Whole homogenates of liver, kidney, spleen and adrenal glands of rat and rabbit convert DDVP mainly to dimethyl phosphate but some des-methyl DDVP, monomethyl phosphate and inorganic phosphate are also formed. No evidence of any other P containing metabolites was obtained. Dimethyl phosphate accounts for 98% to 100% of the DDVP hydrolysed by the plasma of both species. Liver enzymes metabolize des-methyl DDVP further via dichloroacetaldehyde to dichloroethanol and possibly dichloroacetic acid. The stimulatory or otherwise effect of various cations, e.g., Mn and Co, on the enzyme activities is examined and the mechanisms of the hydrolysis of DDVP in these systems are discussed. (J. Sci. Food Agric. 13, 5 (1962) ii-280)

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See also:

497 Radioisotopes in the study of the fate of insecticides applied to animals and plants. (Plapp and Lindquist, 1963)
523 Cl^{36}-dieldrin in mice. (Heath, 1962)
525 Insecticides and metabolism. II. Metabolism of C^{14}-labelled aldrin and C^{14}-labelled dieldrin in microorganisms, liver homogenates and mosquito larvae. (Korte et al., 1962)
526 Syntheses and studies on some C^{14}-labelled insecticides belonging to the halogenated hydrocarbons and on labelled Iridomyrmecin. (Korte et al., 1962)
527 The excretion of C^{14}-labelled aldrin and dieldrin as well as their metabolites via the bile. (Mörsdorf et al., 1963)

529 Microsyntheses of C^{14}-labelled insecticides and some biochemical studies. (Rechmeier, 1962)

538 The metabolism of hexachlorocyclohexane isomers and the effect of microsome-activating drugs. (Koransky and Portig, 1962)

540 Absorption, distribution and excretion of hexachlorocyclohexane isomers in relation to their anticonvulsive effect. In: 3rd Spring meeting of the German Pharmacological Association, 1962. (Portig and Koransky, 1962)

545 Metabolism of chlorophenothene (DDT). (Rothe et al., 1957)

547 Synthesis of Telodrin-C^{14} and its transformation by microorganisms, mosquito larvae and rats. (Stiasni, 1962)

554 Metabolism of radiolabeled 3-(dimethoxyphosphinyloxy)-N,N-dimethyl-cis-crotonamide (Bidrin, SD 3562) in beans and mammals. (Menzer, 1963)

556 Biological and chemical properties of dimethoate and related derivatives. (Brady and Arthur, 1963)

557 Reaction of certain phosphorothionate insecticides with alcohols and potentiation by breakdown products. (Casida and Sanderson, 1963)

568 Metabolism of Famophos in mammals and insects. (Sferra, 1962)

571 Distribution of aerially applied malathion-S^{35} in a forest ecosystem. (Giles and Peterle, 1963)

572 The effect of SKF 525A (2-diethylaminoethyl 2:2-diphenylvalerate hydrochloride) on organophosphate metabolism in insects and mammals. (O'Brien, 1961)

578 Toxicological studies of organophosphate anthelmintics. (Timmerman, 1963)

579 The penetration of an anticholinesterase agent (Sarin) into skin. II. Autoradiographic studies. (Blank et al., 1958)

580 Percutaneous absorption of Sarin and two allied organophosphorus cholinesterase inhibitors. (Fredriksson, 1958)

581 The distribution of radioactive phosphorus in the blood and tissues of rabbits treated with tagged isopropyl methylphosphonofluoridate (Sarin). (McPhail and Adie, 1960)

584 Studies on the mode of action of organophosphorus compounds. Part I. Metabolic fate of P^{32}-labeled Sumithion and methyl parathion in guinea pig and white rat. (Miyamoto et al., 1963)

586 Systemic action of two insecticides on arthropod parasites of rabbits and cattle. (Adkins, 1961)

592 Radioactive-labelled phosphoric acid esters. III. The fate of P^{32}-labelled Wotexit following intravenous or intramuscular injection in cattle. (Dedek and Kühnert, 1962)

609 Non-hydrolytic pathway in metabolism of Sevin. (Dorough and Casida, 1963)

610 Non-hydrolytic pathway in metabolism of N-methylcarbamate insecticide. (Dorough et al., 1963)

613 Conjugates of carbamate metabolism of Sevin. (Leeling and Krishna, 1963)

634 Insecticides in metabolism. IV. Iridomyrmecin-(3-C^{14}). (Korte and Schreiber, 1962)

659 Metabolism of radio-labelled systemic insecticides in animals. (Weidhaas et al., 1962)

703 Residue and metabolism of radioactive 4-tert-butyl-2-chlorophenyl methyl methylphosphoramidate administered as a single oral dose to sheep. (Bauriedel and Swank, 1962)

716 Percutaneous absorption of parathion and paraoxon. IV. Decontamination of human skin from parathion. (Fredriksson, 1961)

II-G-3 INSECTICIDE METABOLISM IN PLANTS

II-G-3-a GENERAL

684 Casida, J.E. METABOLISM OF ORGANOPHOSPHATE INSECTICIDES BY PLANTS: A REVIEW. p.49-63 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Current knowledge of the metabolic fate of insecticides in plants is reviewed and documented (104 references), with particular attention to the synthetic routes available for labelling organophosphates with P^{32} and the use of these compounds in metabolism studies. Radioisotopes are considered to provide the most certain method for establishing the metabolic pathway of an insecticide. A detailed table on radiotracer studies on the metabolism of organophosphate insecticides by plants is included which gives details of absorption and translocation, hydrolysis products and non-hydrolyzed metabolites.

II-G-3-b COCOA

685 West African Cocoa Research Inst. ANNUAL REPORT OF THE WEST AFRICAN COCOA RESEARCH INSTITUTE, 1959-60. London, Crown Agents. 1961. 89p.

Armstrong states that, in screening tests of 9 systemic and semi-systemic insecticides, dimethoate (Rogor 40) and methyl-demeton (Meta systox) appeared likely to be the most useful of foliar sprays. In an experiment in which mature leaves at the distal ends of fans and chupons were painted with P^{32}-labelled dimethoate, radioactivity was detected at mean distances from fans and chupons, respectively, of 14 and 19 inches after 1 d, and 72 and 54 inches after 14 d. (From RAE-A 51: 1963, 116).

II-G-3-c COTTON

686 Chatterji, S., Rahalkar, G.W., Sethi, G.R., Saxena, P.N. STUDIES ON THE TRANSLOCATION OF RADIOACTIVE SCHRADAN IN PLANTS AND ITS UPTAKE FROM FILM BY INSECTS. Curr. Sci. 33, 3 (1961) 105-6.

P^{32}-labelled schradan solutions were used in dipping and irrigation experiments on cotton seedlings, and cotton and sugarcane plants, respectively. Rate and degree of translocation indicated that schradan is absorbed by the roots of the plant, the rate of subsequent translocation varying with the species. Uptake of schradan from film was tested on nymphs and adults of Dysdercus koenigii Fabr. (pretreated at various temperatures, then released on filter paper soaked in 1 ml of 0.5% solution of radioactive schradan). All nymphs were dead by the 2nd day. Schradan was picked up from film in considerable quantities, confirmed by assays on dead and live insects. The uptake apparently increased with rise in temperature.

687 Hacskaylo, J., Lindquist, D.A., Clark, J.C. PHORATE ACCUMULATION BY COTTON PLANTS AND RECOVERY FROM SOIL. J. econ. Ent. 54, 3 (1961) 411-3.

Small-plot field tests were used to study phorate uptake by cotton plants following seed and in-furrow granular applications; phorate recovery from the soil was studied also. In-furrow granular treatments with phorate reduced phytotoxicity and gave aphid control similar to that with the standard carbon seed treatment. Studies with P^{32}-labelled phorate showed similar amounts of phorate-equivalents in plants treated by both methods. Radioassay of soil cores showed 70% or more of the radioactivity in the top 1.5 inches 1 to 7 weeks after planting. The combined quantities of radioactivity extractable with chloroform and water decreased with time to a low of about 25% in each of the treatments. Generally, similar amounts of radioactivity were recovered in the chloroform and water extracts. (Auth.)

688 Hacskaylo, J., Lindquist, D.A., Davich, T.B. DIMETHOATE ABSORPTION AND ITS TRANSLOCATION AND DISTRIBUTION IN THE COTTON PLANT. J. econ. Ent. 54, 6 (1961) 1206-9.

Cotton plants grown in sand culture treated with P^{32}-labelled dimethoate accumulated more insecticide in the leaves under environmental conditions which favoured transpiration. Fruiting cotton plants treated with dimethoate as a soil drench accumulated relatively small amounts of the toxicant in the squares and bolls. Less than 1 µg of dimethoate-equivalents was found in the stamens plus pistil of squares upon which the developing boll weevil (Anthonomus grandis Boheman) larvae feed. Young cotton plants grown in dimethoate-treated nutrient solutions did not absorb the insecticide at the same rate they absorbed water. Also, plants grown in nutrient solutions deficient in phosphorus absorbed less insecticide than plants grown in a complete nutrient solution. (Auth.)

689 Hacskaylo, J., Bull, D.L. METABOLISM OF DIMETHOATE IN COTTON LEAVES. J. agric. Food Chem. 11, 6 (1963) 464-6.

The excised-leaf technique was used. P^{32}-labelled dimethoate was used, with a final 99% purity and a specific activity of 3930 cpm/µg. The half life of the systemic insecticide was 1.8 d through 4 half lives, but increased slightly thereafter. 11 metabolites were resolved by paper chromatography, and 8 of these were identified. The metabolite found in largest amount was the carboxy derivative. The oxygen analogue remained relatively constant but consistently less than 6% of the total metabolites recovered. The proposed metabolic degradation of dimethoate after its introduction directly into the cotton leaves is similar to that found in mammals but dissimilar to that reported when the insecticide was applied as a foliar spray. Its metabolism in leaves deficient in N, P, and Fe is also reported.

II-G-3-d MARKET-GARDENING PRODUCE

690 Hascoët, M. ÉVOLUTION DES DÉPÔTS SUPERFICIELS, DIFFUSION ET DÉGRADATION DE DEUX INSECTICIDES ENDOTHÉRAPIQUES: LE DÉMÉTON-S ET L'ENDOTHION DANS QUELQUES PLANTES MARAÎCHÈRES. p.195-210 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance, Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency, 1963.

En l'absence de précipitations atmosphériques, la détoxication des plantes traitées à l'aide d'insecticides endothérapiques dépend à la fois de l'inactivation des dépôts superficiels et de la dégradation du pesticide dans le végétal. Ces deux phénomènes ont été suivis sur plusieurs plantes maraîchères traitées au déméton-S et à l'endothion, marqués respectivement avec ^{32}P et ^{35}S. La vitesse d'inactivation des dépôts superficiels est comparable pour l'endothion et le déméton-S, lorsque les conditions extérieures sont elles-mêmes voisines. Au niveau du feuillage, la persistance du déméton-S et de ses métabolites actifs varie selon la plante traitée. Elle est en général supérieure à celle de l'endothion dont le schéma de désintégration ne comprend que des produits d'hydrolyse atoxiques. Dans les fruits traités au déméton-S, la dégradation apparente semble très rapide; pour l'endothion, au contraire, elle reste comparable à celle que l'on observe dans le feuillage et ne semble pas affectée par la maturité des fruits. Les résidus toxiques retrouvés dans les fruits peuvent être dus, soit à une diffusion de l'insecticide provenant du feuillage, soit à une contamination directe. L'importance relative de ces deux phénomènes a pu être précisée grâce à une étude comparative des fruits, traités ou non, portés par une plante elle-même traitée. La pénétration et la diffusion du déméton-S et de l'endothion dans les pousses d'asperges sont étudiées afin de tenter d'expliquer le comportement de ces deux insecticides dans la lutte contre la mouche (Platyparea poeciloptera). Le mémoire met en évidence le rôle important que peut jouer le mouillant.

691 Lindquist, D.A., Hacskaylo, J., Davich, T.B. ABSORPTION AND TRANSLOCATION OF PHORATE* AND PHOSPHORUS BY COTTON SEEDLINGS. Bot. Gaz. 123 (1961) 137-40.

Absorption of P^{32}-labelled phorate by the seedlings depended on the volume of the radicle or hypocotyl exposed to the substance. $H_3P^{32}O_4$ was translocated downward in the plants more rapidly than was phorate; the reverse was true of upward translocation. (J. Sci. Food Agric. 13, 9 (1962) ii-89).

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* O,O-diethyl S-(ethylthio)methyl phosphorodithioate

692 Lindquist, D.A., Hacskaylo, J., Davich, T.B. LABORATORY AND FIELD INVESTIGATIONS WITH PHORATE-TREATED COTTON SEEDS. J. econ. Ent. 54, 2 (1961) 379-85.

The absorption of P^{32}-labelled phorate by cotton seeds was investigated under laboratory, greenhouse, and field conditions. Dehulled seeds absorbed much more phorate than intact seeds; however, this increased amount of phorate in the dehulled seed did not reduce germination or radicle growth. Absorption of inorganic P^{32} was not appreciably inhibited by the seed coat. Water absorption and respiration of germinating cotton seeds was not markedly different between untreated and treated seeds. Cotton plants grown in sand and soil from phorate-treated seeds absorbed 2% to 6% of the applied dosage, chiefly during the first 7 d after planting. (Auth.)

693 Lindquist, D.A., Hacskaylo, J., Clark, J.C., Davich, T.B. SYSTEMIC ACTIVITY OF DIMETHOATE APPLIED TO COTTON SEEDS. J. econ. Ent. 54, 6 (1961) 1132-5.

Dimethoate was not exceptionally effective as a systemic cottonseed treatment against the boll weevil (Anthonomus grandis Boheman) and cotton aphid (Aphis gossypii Glover). Applied as a seed treatment, dimethoate caused considerable reduction in seedling emergence. Studies with P^{32}-labelled dimethoate applied as a cottonseed treatment indicated that the toxicant was most rapidly absorbed 1 to 3 d after planting. Dimethoate seed treatment did not reduce the total emergence of artificially deteriorated seed, but did reduce the rate of emergence somewhat. Seeds deteriorated for 2 d absorbed more dimethoate than seeds deteriorated for 0, 1, 3, or 4 d. Dimethoate was found to be less toxic than phorate to boll weevil larvae and adults. (Auth.)

694 Tsao, C.H., Clark, E.W. ABSORPTION AND TRANSLOCATION OF Di-SYSTON BY COTTON PLANTS. J. econ. Ent. 54, 6 (1961) 1228-9.

The absorption and translocation of P^{32}-labelled Di-Syston (O,O-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate) were studied by means of foliar, seed, and soil treatments. The compound was readily translocated to leaves and stems from treated leaves or roots, but in these limited experiments it did not concentrate in fruiting forms. Distribution of Di-Syston leached from germinated and ungerminated treated cottonseed into the surrounding soil showed definite downward and, to a lesser degree, lateral movement. (Auth.)

II-G-3-e GRAPE VINE

695 Coombe, B.G. ABSORPTION AND MOVEMENT OF PHOSPHORUS-32-LABELLED SYSTEMIC INSECTICIDES IN THE GRAPE VINE (Vitis vinifera L.). Aust. J. agric. Res. 13 (1962) 17.

Schradan, dimefox and demeton-S, containing P^{32}, were applied by different methods at different times to study their behaviour, particularly their accumulation in roots, as a means of controlling the root-sucking pest, Phylloxera vitifoliae. Foliage sprays, 'capsule' treatment, and banding of the trunk (with various treatments such as cincturing, abrasion and twig removal) gave low insecticide levels in the roots, but sometimes high levels in the leaves. Watering in November and February, and shoot injection in April, have 17 mg of schradan per kg of roots, 15 d after treatment, and decomposition was slow. Dimefox was absorbed to a similar extent but decomposed rapidly and was phytotoxic when applied in a trunk band. Demeton-S gave low root levels and did not move easily in the phloem.

II-G-3-f PINE APPLE

696 Gortner, W.A. RADIOISOTOPE STUDIES OF PESTICIDE METABOLISM BY THE PINEAPPLE PLANT. Int. J. appl. Rad. Isotopes 13 (1962) 395-7.

Review of relevant activities in author's institute. C^{14}, P^{32} and S^{35} were used in a series of studies. Radioactive Systox, di-syston (Bayer 19639) and dimethoate were studied as systemic insecticides. Results of experiments with S^{35} indicated that inadequate insect control was not due to detoxification or immobilization mechanisms in the plant, but rather to inadequate penetration of the insecticide into tissues at the sites of application. Radioactive mealybugs (Pseudococcus brevipes) were obtained by feeding on C^{14}-labelled pineapple leaves or nutrient media containing P^{32}. Paper chromatography and subsequent autoradiography permitted identification of the free tagged amino acids and sugars in the insects themselves, in their oral secretions and in their excretions. Some interesting differences were observed in the autoradiographs.

II-G-3-g POPLAR

697 Catrina, I., Popa, A., Constantinesco, V., Constantinesco, O., Constantinesco, El., Huluta, C. L'ÉTABLISSEMENT DES PROCESSUS D'ABSORPTION ET DIFFUSION DES INSECTICIDES SYSTÉMIQUES AU Populus X euramericana de Guinier "robusta". p.211-20 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency, 1963.

Pour étudier le mécanisme d'absorption, de diffusion et de localisation des insecticides systémiques en ce qui concerne les peupliers et les saules, espèces fréquemment attaquées par les insects xylophages, on a fait des recherches en employant le «Dipterex» marqué sur le peuplier Robusta R20. Le marquage de l'insecticide a été fait dans un réacteur, en utilisant comme cible le Dipterex en poudre (1,5 g), avec un flux $\Phi = 10^{11}\ n/cm^2 \cdot s$ et à une température de 30 à 40°C. L'irradiation a été effectuée jusqu'à l'obtention d'une activité absolue de la cible ≅ 1 mc. Tant en laboratoire qu'en pépinière, l'insecticide a été accumulé en plus grande proportion dans les feuilles. Pourtant, on constate une augmentation importante des accumulations d'insecticide dans les rameaux et dans le bois de la tige, surtout au bout des plants, dans l'expérience en pépinière. En général, l'accumulation d'insecticide a été de 1,65 mg/g substance verte en pépinière, contre 0,24 mg/g en pots. Il en résulte que, dans les conditions de terrain, les plants de peuplier Robusta de 2 ans, pendant le temps sec, peuvent mobiliser le Dipterex administré en solution aqueuse à raison de 9,3% de la quantité versée dans le sol, contre 1,35% dans les expériences en laboratoire. L'administration des solutions sur les feuilles par pulvérisation a un rendement faible d'absorption de l'insecticide, grâce aussi bien au mécanisme difficile d'absorption des feuilles qu'au lavage de l'insecticide par l'eau de pluie, la rosée et le brouillard. On a décelé une grande quantité d'insecticide sur le sol; c'est pourquoi les auteurs considèrent que la méthode d'administration des solutions d'insecticides systémiques dans le sol doit être adoptée en priorité dans la lutte contre les ennemis des essences ligneuses. (From auth.)

II-G-3-h RICE

698 Ishii, S., Hirano, C. TRANSLOCATION OF γ-BHC IN RICE PLANT CULTURED IN AQUEOUS SOLUTION OF C^{14}-γ-BHC. Jap. J. appl. Ent. Zool. 6, 1 (1962) 28-33. (In Japanese, with English summary).

It has been confirmed that 1st brood larvae of the rice stem borer, Chilo suppressalis Walker, can be killed when γ-BHC is applied to the paddy field soil before transplanting rice seedlings. In order to establish the translocation route to the borer zone, γ-BHC-1-C^{14} (9.4 mg at 0.4 μc/mg to 1 litre of water) was used in culture solutions (final concentration < 9.4 ppm). Rice seedlings of about 40-50 cm in height were cultured in water for 1 week, to develop new roots. After immersion of the roots in culture solution for 65 or 119 h, the treated seedlings were exposed on X-ray film for about 3 months. Autoradiograms show that γ-BHC is absorbed from the roots and translocated to stems and leaves through vascular bundles. In other experiments absorbant cotton soaked with vaseline was applied to the stem to check on capillary creeping, once the roots were immersed in the radioactive solution. Paper chromatography and gas flow counters were used for assaying. Results indicate that γ-BHC dissolved in water is not only absorbed and translocated to stems and leaves but also creeps up over the surface of leaf sheaths by capillary action. For γ-BHC applied to irrigation water from the surface the main route of translocation appears to be via the leaf sheath surfaces.

699 Tomizawa, C., Sato, T. METABOLIC FATE OF MALATHION AND METHYL PARATHION IN RICE PLANT. Jap. J. appl. Ent. Zool. 6, 1 (1962) 70-5. (In English).

The metabolic fate of S^{35}-labelled malathion and methyl parathion, sprayed on rice plants, was examined. When the metabolic rate of the insecticides was examined by the partition ratio of the insecticide metabolites between chloroform and trichloroacetic acid in aqueous solution, the greater part of the insecticide metabolites contained in rice grains was water-extractable even 1 week after spraying. The water extracts of the insecticide metabolites in rice grains were subjected to ion exchange chromatography, and the existence of several hydrolysis products was confirmed for both malathion and methyl parathion. The main metabolites were thiophosphoric acid malathion, and thiophosphoric acid, O,O-dimethyl thiophosphoric acid and O-p-nitrophenyl thiophosphoric acid for methyl parathion.

II-G-3-j TEA AND CABBAGE

700 Tomizawa, C., Fukuda, H., Masuda, T., Miyahara, Y. FATE OF O,O-DIMETHYL O-(3-METHYL-4-METHYLMERCAPTOPHENYL) THIOPHOSPHATE SPRAYED ON TEA AND CABBAGE LEAVES. Jap. J. appl. Ent. Zool. 6, 3 (1962) 237-41. (In English, with Japanese summary).

Fenthion (Baycid) labelled with P^{32} was used to study the behaviour of the compound in tea and cabbage leaves. Penetration and metabolism appeared to be more rapid in the cabbage. The PS-sulphoxide and PS-sulphone were the principal metabolites in the tea leaves, and other chloroform-extractible products were scarce. The results for cabbage were not the same, and the appearance of a metabolite suggesting oxidation to the corresponding phosphate was observed. The amounts and distribution of the metabolites in green tea were little altered by the process of manufacture. (RAE-A 52: 1964, 301).

II-G-3-k SUGAR CANE

See 686

II-G-3-l METABOLIC EFFECTS OF INSECTICIDES ON (labelled) PLANTS
(wheat, potatoes, apple trees)

701 Богдарина, А.А., Зазерина, А.Н. О ПОСТУПЛЕНИИ ФОСФОРА (P^{32}) И АЗОТА В РАСТЕНИЕ ПРИ ПРИМЕНЕНИИ ХЛОРОРГАНИЧЕСКИХ ИНСЕКТИЦИДОВ. Стр. 40-2 в сб. "Материалы Симпозиума по применению биофизики в области защиты растений". Л. 1961. Р. Ж. Биол. №17Г70. 1962.

Bogdarina, A.A., Zazerina, A.N. ASSIMILATION OF PHOSPHORUS (P^{32}) AND NITROGEN BY PLANTS TREATED WITH CHLORINATED ORGANIC INSECTICIDES. p.40-2 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961. R. Zh. Biol. No. 17G70. 1962.

The effect of varying doses of hexachloran and DDT on the assimilation of P^{32} by plants was studied on wheat, potatoes, and apple trees. The exposure was for 3.5 h and 2-10 d. The characteristics of P absorption by plants were intimately related to the nature of insecticide action and to the duration of exposure of the plants to the poisons and environmental conditions. By using stimulating doses of the preparations P assimilation was accelerated and 1.5-2-fold more P^{32} accumulated in treated plants than accumulated in those untreated. Inhibiting doses of the insecticides caused a decrease in assimilation and accumulation of P^{32} within 3 d. Phytocidal doses suppressed P^{32} absorption for a long period. Combined use of insecticides and P accelerated N absorption. Efficient use of insecticides in combination with fertilizers protects the plants from harmful organisms and increases yield. (CA 58: 1963, 10518a)

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See also:

508 The metabolism of hydrocyanic acid. (Tschiersch, 1963)
510 Studies on the mechanism of fumigants. (Jap. Food Research Inst. Tokyo, 1962)
518 The absorption of sulphur dioxide by fir trees. (Materna and Kohout, 1963)
519 The spatial distribution of S^{35} and the identity of the tagged compounds in leaves of spinach after treatment with $S^{35}O_2$ gas. (Weigl and Ziegler, 1962)
526 Syntheses and studies on some C^{14}-labelled insecticides belonging to the halogenated hydrocarbons and on labelled Iridomyrmecin. (Korte et al., 1962)
529 Microsyntheses of C^{14}-labelled insecticides and some biochemical studies. (Rechmeier, 1962)
536 Systemic nature of γ-BHC in plants. Mode of action of BHC. II. (Ishii et al., 1959)
541 Girdling experiments on the translocation of topically applied radioactive γ-benzene hexachloride-C^{14} in certain woody plant with insect galls. (Torii, 1961)
551 Fate of O,O-dimethyl O-(3-methyl-4-methylmercaptophenyl) thiophosphate sprayed on rice plants. (Fukuda et al., 1962)
554 Metabolism of radiolabeled 3-(dimethoxyphosphinyloxy)-N,N-dimethyl-cis-crotonamide (Bidrin, SD 3562) in beans and mammals. (Menzer, 1963)
558 Behaviour of P^{32}-labelled Rogor applied to plants [by spray treatment]. I. Penetration and translocation of Rogor P^{32} applied to the trunk of the lemon tree. (Pietri-Tonelli and Barontini, 1961)
559 Behaviour of P^{32}-labelled Rogor applied to plants [by spray treatment] II. Penetration and translocation of P^{32}-labelled Rogor sprayed on crops. (Pietri-Tonelli and Barontini, 1961)
560 Behaviour of P^{32}-labelled Rogor applied to plants [by spray treatment]. III. Penetration and translocation of P^{32}-labelled Rogor applied by spraying herbacious plants and trees. (Pietri-Tonelli and Barontini, 1961)
562 Systemic migration and insecticidal activity of dimethoate applied on tree trunks. (Pietro-Tonelli et al., 1961)
563 Penetration, translocation and metabolism of P^{32}-labelled Rogor applied to the trunk of the lemon tree. (Santi, 1961)
564 Metabolic fate of P^{32}-labelled dimethoate in olive fruits and some toxicological implications. (Santi and Giacomelli, 1962)
565 Study on the metabolism of P^{32}-labelled Rogor in sugar and fodder beet. (Santi et al., 1962)
566 Penetration, translation, and metabolism of Rogor-^{32}P applied on lemon tree trunks. (Santi, 1961)
569 Chemical and biological behavior of fenthion residues. (Metcalf et al., 1963)
570 On the occurrence of biologically active metabolites of the active ingredient S 1752 after application of LEBAYCID®. (Niessen, 1962)
571 Distribution of aerially applied malathion-S^{35} in a forest ecosystem. (Giles and Peterle, 1963)

576 The synthesis of phosphamidon and its decomposition in plants. (Anliker *et al.*, 1961)
584 Studies on the mode of action of organophosphorus compounds. Part I. Metabolic fate of P^{32}-labelled Sumithion and methyl parathion in guinea pig and white rat. (Miyamoto *et al.*, 1963)
585 Penetration and translocation of a systemic insecticide. (Costa *et al.*, 1963)
590 Radioactive-labelled phosphoric acid esters. I. Preparation of P^{32}-labelled isomers of the β-methylmercaptoethyl thiophosphoric dimethyl ester and their hydrolytic breakdown in the plant. (Dedek *et al.*, 1962)
595 Radical absorption of P^{32}-labelled *O,O*-dimethyl-*S*-benzene sulfonyl phosphorodithioate. (Fontana and Silva, 1963)
609 Non-hydrolytic pathway in metabolism of Sevin. (Dorough and Casida, 1963)
619 Metabolism of radio-labeled SD-3562 in insects and cotton leaves. (Bull and Lindquist, 1962)
632 Absorption and metabolism of dimethoate in the bollworm and boll weevil. (Bull *et al.*, 1963)
661 Metabolism of *O,O*-dimethyl *O*-[4-(methylthio)-*m*-tolyl] phosphorothioate by white rats. (Brady and Arthur, 1961)
682 Metabolism of 2,2-dichlorovinyl dimethyl phosphate in relation to residues in milk and mammalian tissues. (Casida *et al.*, 1962)
725 Locale and metabolism of methyl parathion and Guthion in the cotton leaf. (Shipp, 1963)

II-H Insecticide Residues in

II-H-1 ANIMALS AND ANIMAL PRODUCTS

II-H-1-a GENERAL

702 Haller, H.L. THE USE OF ATOMIC ENERGY TO STUDY AGRICULTURAL CHEMICAL RESIDUES. p.147-60 in "Applications of Radioisotopes and Radiation in the Life Sciences 1961". Hearings before the Subcommittee on Research, Development, and Radiation of the Joint Committee on Atomic Energy, Congress of the United States. 87th Congress, 1st Session, 27-30 March 1961.

Review article on applications of radioisotopes to pesticides. The usefulness of labelling for studying their structure and mode of action is discussed, and particular stress laid on their role in residue determinations.

See also:

567 Metabolism of systemic and other recent insecticides in animals. (Arthur, 1962)
658 Use of radioisotopes in studying the absorption, distribution and elimination of certain insecticides in animals. (Filatov *et al.*, 1963)
1549 Instrumentation in pesticide residue determinations. (Gunther, 1962)
711 Polymer-insecticide systems as livestock feed additives. (Abstr. 283). (Lloyd and Matthysse, 1963)
717 Some problems in the determination of residues in plants and mammals. (Heath, 1963)

II-H-1-b SHEEP

703 Bauriedel, W.R., Swank, M.G. RESIDUE AND METABOLISM OF RADIOACTIVE 4-*tert*-BUTYL-2-CHLOROPHENYL METHYL METHYLPHOSPHORAMIDATE ADMINISTERED AS A SINGLE ORAL DOSE TO SHEEP. *J. agric. Food Chem.* *10* (1962) 150-4.

Sheep were given single oral doses of P^{32}-labelled Ruelene (weighed into gelatin capsules and administered with a balling gun). The metabolic fate was studied, and the residue in the tissues was determined for periods up to 21 d post-treatment. Ruelene and several hydrolysis products were found in the blood shortly after treatment, but by 2 d the Ruelene had decreased to a low level. Over 85% of the administered P^{32} was recovered in the excreta. The P^{32} in the urine, amounting to 75% of the dose, was primarily in the form of hydrolysis products of Ruelene. Some of the Ruelene was hydrolyzed completely to inorganic phosphate and retained in the animal tissues, in part as natural phosphate esters and in part as inorganic phosphate. Ruelene itself was not found in the tissues after 7 d.

II-H-1-c CATTLE - MEAT AND DAIRY PRODUCTS

704* Cutkomp, L.K. PESTICIDES RESIDUES. USE OF RADIOACTIVE TRACER METHOD TO DETERMINE POSSIBLE RESIDUES IN MILK AND MEAT FROM DAIRY COWS. Paper No. 1727. Miscellaneous Journal Series, Minnesota Agricultural Experiment Station, St. Paul. 6p. 1960.

The suitability of the isotope dilution method for such residue determinations is discussed. The method is illustrated for C^{14}-labelled methoxychlor in milk. It is suggested that such techniques might be profitably incorporated in early toxicological studies on rats before using cows.
(Paper presented during 46th midyear meeting, Chemical Specialities Manufacturers Association, Chicago, 17 May 1960).

705 Roberts, R.H., Chamberlain, W.F. FACTORS CONTRIBUTION TO THE LOSS OF INSECTICIDE DEPOSITS ON CATTLE. *J. econ. Ent.* *56*, 5 (1963) 614-8.

Comparisons of photographs taken at various times after spraying whitewash on cattle, bioassays of selected areas on cattle sprayed with DDT and methoxychlor, and radiometric measurements of hair and urine taken during and after confinement from a steer sprayed with C^{14}-labelled DDT, showed that most of the loss of dermal treatments from an animal's body could be accounted for by the abrasive action of the tail, contact with ground, rubbing and other exercise, rain, and licking. (Auth.)

706 Kartashova, V.M., Kartashov, P.A. DETERMINATION OF RESIDUES OF TOXIC PRINCIPLES IN MILK AND MEAT BY THE USE OF RADIOACTIVE INDICATORS. p.105-6 in "Radioaktivnўe, Izotopў i Yadernўe Izlucheniya v Narodnom Khozyaĭstve SSSR. Trudў Vsesoyuznogo Soveshchaniya, Riga, 1950". 1961. (In Russian).

The uptake of DDT and hexachlorocyclohexane (I) labelled with C^{14} and Cl^{36}, respectively, by the cow through the skin, the outflow of radioactivity after loading, and toxicity of milk containing *I* were studied. A cow was sprayed with DDT in oil in 2 doses of 30 and 23.9 mc C^{14}/kg body weight at interval of 135 d and sacrificed on the 45th day after the 2nd spraying. It resulted in secretion into the milk of 3.22-82 mg of DDT within the first 10 d. In urine and faeces 2/3 of DDT was excreted and 80% of DDT in milk remained unchanged. DDT was deposited in all parts of the animal body. A 2nd cow treated with 8 applications of 1 l each of an aqueous mineral-oil emulsion containing 2% *I*, at intervals of 3 d gave milk containing the following amounts (*I*/l of milk): 1st treatment 19 mg after 6 h, 8th treatment 148 and 216 mg after 6 and 24-48 h, respectively. *I* was secreted in the milk in appreciable quantities for at least 2 months after treatment was discontinued. Kittens fed 150-200 g of this milk daily became moribund, developed twitching of limbs, and finally died after 7-11 d. (CA 56: 1962, 6420h).

707 Roberts, R.H., Claborn, H.V., Radeleff, R.D. RESIDUES IN THE MILK OF DAIRY COWS SPRAYED WITH P^{32}-LABELED GENERAL CHEMICAL 4072. *J. econ. Ent.* *54*, 5 (1961) 1053-4.

An alkylated aryl polyether alcohol, General Chemical 4072 (2-chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate) was labelled with P^{32}. Samples were used to study the secretion of the compound in the milk following applications to two dairy cows. A table lists the amount of milk produced, percentage of butterfat, and ppm of organosoluble residue in milk of treated cows. Data indicate that absorption, as determined by the secretion levels, is greater when the spray is brought into contact with the skin.

708 Timmerman, J.A., Jr., Buttram, J.R., Dorough, H.W., Arthur, B.W. *IN VITRO* STABILITY AND RECOVERY OF INSECTICIDES FROM MILK. *J. econ. Ent.* *54*, 3 (1961) 441-4.

Extraction techniques used are described. Aliquots of the acetonitrile, n-hexane, water, and milk residue were assayed for total radioactivity. The P^{32}-labelled Co-Ral, Ruelene®, Bayer 29493, and Bayer 22408 were assayed with an end-window GM-tube; the analysis of C^{14}-labelled DDT and Cl^{36}-labelled Kepone®, and dieldrin were made with a windowless gas-flow counter according to radiometric procedure described previously*. The percentage recovery of these insecticides from milk was based on the amount of radioactivity appearing in the final acetonitrile fraction from 4 separate determinations. Recoveries of Sevin® (1-naphthyl *N*-methylcarbamate), Kepone® (decachlorooctahydro-1,3,4-metheno-2H-cyclobuta [cd] pentalen-2one), Bayer 29493 (*O,O*-dimethyl *O*-[4-(methylthio)-m-tolyl] phosphorothioate), Bayer 22408 (*O*-naphthalimido-*O,O*-diethyl phosphorothioate), Ruelene® (*O*,4-tert-butyl-2-chlorophenyl *O*-methyl methylphosphoramidate), and CoRal® (*O,O*-diethyl *O*-(3-chloro-4-methylumbelliferone) phosphorothioate) from milk ranged from 87% to 97% using acetonitrile and chloroform as the primary extraction solvents and acetonitrile-n-hexane as a cleanup procedure. This extraction procedure was somewhat less effective for removing known amounts of DDT and dieldrin from milk. Acetonitrile-chloroform extraction of milk was usually more efficient for removing insecticides than was a 2:1 mixture of diethyl ether and n-hexane. Ruelene, Bayer 22408, and Bayer 29493 were stable in vitro in raw milk for periods up to 14 d of incubation, but after 3 d incubation, some Co-Ral equivalents remained in the milk residue following acetonitrile-chloroform extraction.

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* J. econ. Ent. 53: 1960, 848.

709 McKinley, W.F., Savary, G. INSECTICIDE RESIDUES. PROCEDURE FOR CLEANUP OF BUTTERFAT PRIOR TO ANALYSES FOR DIELDRIN* RESIDUES. J. agric. Food Chem. 10, 3 (1962) 229-32.

A procedure is presented for the isolation of dieldrin from 50-g samples of butter oil. The dieldrin obtained was free enough from extraneous fatty material to be identified by paper chromatography. The procedure consists of partitioning the fat between acetonitrile and n-hexane followed by elution from a Darco G60-Solka Floc column with acetone. The procedure was tested by using C^{14}-labelled dieldrin.

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* 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,-8a-octahydro-1,4-endo-exo-5,8-dimethanonaphthalene.

710 Schmitt, R.A., Zweig, G. TOTAL ORGANIC CHLORIDE CONTENT IN BUTTERFAT BY A RAPID METHOD OF NEUTRON ACTIVATION ANALYSIS. J. agric. Food Chem. 10, 6 (1962) 481-4.

A rapid neutron activation method has been developed and applied successfully for the determination of the total organic chloride content in milk products. This neutron activation procedure consists of irradiating butterfat and a chlorine reference standard in a nuclear reactor for a short time and subsequently measuring and comparing the induced Cl^{38} radioactivity. (Both chlorine isotopes, Cl^{35} and Cl^{37}, absorb thermal neutrons and become Cl^{36} and Cl^{38}, with half-lives of 3×10^5 years and 37.3 min respectively. Since the number of radioactive disintegrations in a chlorinated specimen is inversely proportional to the half-life of the species, Cl^{38} is pertinent for neutron activation analysis). From the total chloride content in milk products, an upper limit for the content of chlorinated pesticides in milk products may be estimated. Numerous tables are included.

II-H-1-d CATTLE - MANURE

711 Lloyd, J.E., Matthysse, J.G. POLYMER-INSECTICIDE SYSTEMS AS LIVESTOCK FEED ADDITIVES. (Abstr.283). Bull. ent. Soc. Amer. 9, 3 (1963) 174.

Rate of C^{14} and H^3 tagged insecticide elution from insecticide-polymer systems was compared in vitro aqueous* and in the digestive tract of cattle. Goal is minimum absorption by the animal and maximum release into manure for larviciding. Rates of release were uniform. Polyvinyl chloride was most promising.

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* Compiler: in aqueous solution?

II-H-1-e POULTRY

712 Buttram, J.R., Arthur, B.W. MAGNITUDE AND NATURE OF RESIDUES IN TISSUES AND EGGS OF POULTRY RECEIVING RUELENE IN THE FEED. J. econ. Ent. 54, 3 (1961) 456-60.

Ruelene® (4-tert-butyl-2-chlorophenyl methyl methylphosphoramidate) was rapidly metabolized by laying hens receiving the compound in the diet for 7 d at 100 ppm. Acetonitrile-soluble residues were dissipated from several tissues by the time the hens were returned to normal feed for 3 d, but appeared in egg yolks at 3 to 5 d after the hens were returned to normal feed. These acetonitrile-soluble residues were not characterized as Ruelene. Ruelene was degraded to phosphoric acid that was incorporated into normal phosphorus-containing constituents, particularly in bone tissue. Only 29% of the Ruelene consumed in the feed was eliminated in the feces during the 21-d experimental period. Six metabolites were isolated from the excreta and there was a possibility that nine metabolites were present. O-methyl phosphoric acid and 4-tert-butyl-2-chlorophenyl methyl phosphoric acid were tentatively identified. The in vivo degradation of Ruelene is complex, involving enzymatic attack at the three different groupings of the molecule.

713 Dorough, H.W., Brady, U.E., Jr., Timmerman, J.A. Jr., Arthur, B.W. RESIDUES IN TISSUES AND EGGS OF POULTRY DUSTED WITH CO-RAL (BAYER 21/199). J. econ. Ent. 54, 1 (1961) 25-30.

Thirty White Leghorn hens were dusted with P^{32}-labelled Co-Ral® (O,O-diethyl O-(3-chloro-4-methylumbelliferone) phosphorothioate or Bayer 21/199) at 50 mg/kg. Twenty hens were dusted once, while 10 hens received 2 applications at weekly intervals. Some intact Co-Ral remained on the feathers and skin for 28 d after treatment. The liver, kidney, and bone contained more radioactivity than other internal tissues. By 3 d after treatment, acetonitrile-soluble residues in internal tissues were negligible. The eggs contained minute quantities of aceto-nitrile-soluble residues at 5 to 7 d after treatment of the hens, but these residues were not characterized as Co-Ral or its oxygen analog. Radioactive materials excreted in the faeces consisted of residual Co-Ral, the oxygen analog, O,O-diethyl phosphoric and O,O-diethyl phosphorothioic acids. Phospholipids, ribose nucleic acid, desoxyribose nucleic acid and acid-soluble phosphorus compounds were isolated from the liver and faeces. (Auth.)

714 Dorough, H.W., Brady, U.E. Jr., Timmerman, J.A. Jr., Arthur, B.W. RESIDUES IN TISSUES AND EGGS OF POULTRY RECEIVING CO-RAL(BAYER 21/199) IN THE FEED. J.econ.Ent. 54, 1 (1961) 97-100.

P^{32}-labelled Co-Ral® was mixed in laying mash at 100 ppm and fed to laying hens for a max. of 7 d. The highest concentration of total radioactive residues was in the liver and kidney; deposition of Co-Ral or metabolites in the fat was minor. The liver, kidney, and gizzard contained the highest concentration of acetonitrile-soluble materials. Acetonitrile-soluble residues were not present in any tissue after the hens were returned to normal feed for 7 d. Small but detectable amounts of acetonitrile-soluble materials were present in egg yolks analyzed at 11 to 15 d after treatment, but none was present in the albumin. About 79% of the radioactivity consumed in the feed was excreted in the faeces by 28 d posttreatment; more than 85% of the excreted radioactive materials were hydrolytic products. Unchanged Co-Ral, the oxygen analog of Co-Ral(O,O-diethyl phosphoric acid) and O,O-diethyl phosphorothioic acid were isolated and characterized from the faeces. (From auth.)

715 Dorough, H.W., Arthur, B.W. DISTRIBUTION AND SOLUBILITY PROPERTIES OF PHOSPHORIC AND O,O-DIETHYL PHOSPHORODITHIOIC ACIDS FED TO LAYING HENS. J. econ. Ent. 54, 6 (1961) 1140-3.

P^{32}-labelled phosphoric acid and O,O-diethyl phosphorodithioic acid were fed at 100 ppm in the diet of laying hens for 7 d. The liver, kidney, and bone accumulated more radioactive materials than the blood, brain, breast, fat, feathers, gizzard, or skin. Egg yolk contained more acid equivalents than the shell or white. Acetonitrile-soluble residues were detectable in the faeces, egg yolk, and liver. About 46% of the phosphoric acid and 36% of the diethyl phosphorodithioic acid consumed in the feed were present in the faeces 14 d after treatment of hens. The phosphoric acid and diethyl phosphorodithioic acid exhibited solubility properties characteristic of many organophosphate insecticides. (Auth.)

II-H-1-f MAN

716 Fredriksson, T. PERCUTANEOUS ABSORPTION OF PARATHION AND PARAOXON. IV. DECONTAMINATION OF HUMAN SKIN FROM PARATHION. Arch. envir. Hlth 3 (1961) 185-8.

The efficiency of a decontamination procedure for removing P^{32}-labelled parathion (E 605, diethyl 4-nitrophenyl thionophosphate) from the skin surface of human volunteers was tested. Two series of experiments, each using 4 men, were performed, the material being left on the skin for 30 and 300 min, respectively. The radioactivity was determined before and after the cleansing procedure, and the residue calculated as percentage of the initial count after substraction of the background count. After ordinary washing with soap and water for 30 sec a residue of ~30-50% and 8-20% for the long-term and short-term groups, respectively, remained. An alcohol wash immediately after the initial cleansing still left a considerable residue (> 10% and ~5%, respectively). A final cleansing with soap and water left a residue of > 5% in the long-term series, the skin being almost completely decontaminated for the other. The theoretical aspects of the time factor involved are discussed and the practical implications within the field of occupational medicine stressed. (From auth. summary)

See also:

676 The metabolism of orally administered malathion by a lactating cow. (O'Brien et al., 1961)
678 Studies on the percutaneous absorption of parathion and para-oxon. II. Distribution of ^{32}P-labelled parathion within the skin. (Fredriksson and Bigelow, 1961)
679 Tissue distribution of P^{32}-labeled parathion. Autoradiographic technique. (Fredriksson and Bigelow, 1961)
671 Detection and distribution of ^{32}P labelled diazinon in dog tissues after oral administration. (Millar, 1963)

673 The metabolism of P^{32}-labeled dimethoate in sheep. (Chamberlain *et al.*, 1961)

662 Absorption and metabolism of Bayer 22408 by dairy cows and residues in the milk. (Buttram and Arthur, 1961)

667 A study of the absorption of ^{14}C-labelled DDT from water by fish. (Holden, 1962)

592 Radioactive-labelled phosphoric acid esters. III. The fate of P^{32}-labelled Wotexit following intravenous or intramuscular injection in cattle. (Dedek and Kühnert, 1962)

659 Metabolism of radio-labelled systemic insecticides in animals. (Weidhaas *et al.*, 1962)

578 Toxicological studies of organophosphate anthelmintics. (Timmerman, 1963)

590 Radioactive-labelled phosphoric acid esters. I. Preparation of P^{32}-labelled isomers of the β-methylmercaptoethyl thiophosphoric dimethyl ester and their hydrolytic breakdown in the plant.

II-H-2 INSECTICIDE RESIDUES IN PLANTS AND PLANT PRODUCTS

II-H-2-a GENERAL

717 Heath, D.F. SOME PROBLEMS IN THE DETERMINATION OF RESIDUES IN PLANTS AND MAMMALS. p.185-92 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Chemical and biochemical methods of residue determination assume that the nature of the toxic compounds present is known, and that they can be extracted in known yields. Neither assumption is easily validated except by using radioisotopes. The use of radioisotopes to investigate these problems is described, with examples taken from work on demeton and dimefox (P^{32}) and the fungicide triphenyltin acetate (Sn^{113}).

718 Adams, J.M., Anderson, C.A., McDougall, D. THE DETECTION OF RESIDUES OF SYSTOX AND ITS TOXIC METABOLITES IN THE PRESENCE OF OTHER ORGANOPHOSPHORUS PESTICIDES. *J. agric. Food Chem.* *11* (1963) 178-80.

A method has been developed for detection of residues of Systox and its metabolites in plants. The method is based upon chromatographic separation on paper and subsequent characterization through the use of the colour forming agent, 2,6-dibromo-N-chloro-p-quinoneimine. Recovery data were obtained using P^{32}-labelled compounds. The radioactivity was measured on paper chromatograms with a strip counter. In 11 of the 20 cases recoveries were $\geq 75\%$, in 7 ~50-75%, and only in 2 $< 50\%$. Even considering the low recoveries obtained in a few cases, the method is still capable of detecting 0.3 ppm of the Systox thiol isomer or the sulfoxide or sulfone of either isomer. The thiono isomer sulfone was not included in this recovery experiment as radio-labelled material was not available. The method will distinguish residues of Systox and its metabolites in the presence of other organophosphorus pesticides and cholinesterase inhibitors. With the application of a preliminary chromatographic cleanup procedure, the method has been used for the detection of Systox residues in a large number of crops.

719 Danbara, H., Tomizawa, C. ELIMINATION OF RESIDUAL AGRICULTURAL CHEMICALS. II. CONTAMINATION WITH BAYCID (O,O-DIETHYL O-(3-METHYL-4-METHYLTHIOPHENYL) THIOPHOSPHATE). *Igaku to Seibut.* *59*, 5 (1961) 145-7.

A tendency similar to methyl parathion was observed with P^{32}-labelled Baycid. (CA 60: 1964, 4714f).

720 Phillips, F.T. THE APPLICATION AND MEASUREMENT OF LABELLED RESIDUAL INSECTICIDES IN SOME PHYSICO-CHEMICAL STUDIES. p.147-52 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

The disappearance of residual films of insecticides from plant and other surfaces may be conveniently studied if the insecticide is labelled with a radioisotope of sufficient radiant energy to allow for a simple measuring technique. Methods of application of insecticide solutions on different surfaces led to the design of a spray chamber suitable for the distribution of very small amounts (a few drops) of radioactive liquid formulations over a 35-cm^2 circular area. Some measurements of the rates of volatilization of Cl^{36}-labelled dieldrin and aldrin crystals from glass surfaces are included. (Auth.)

II-H-2-b APPLE

721 Bazzi, B., Santi, R., Canale, G., Radice, M. METODI DI MICRODOSAGGIO DEI RESIDUI DI CIDIAL® (ESTERE ETILICO DELL' ACIDO O,O-DIMETILDITIOFOSFORILFENILACETICO) NEI PRODOTTI AGRARI. DETERMINAZIONE NELLE MELE PER VIA COLORIMETRICA IN BASE AL P E PER VIA CROMATOGRAFICA SU STRATO SOTTILE. (Determination of microdosages of Cidial® (ethyl ester of O,O-dimethyldithiophosphoryl-1 phenylacetic acid) in agricultural products. Determination in apples by means of colorimetry based on P by chromatography of this layer). Italy, Istituto di Ricerche Agrarie. Montecatini, Società Generale per l'Industria Mineraria e Chimica - Milano. 1963. n.p. (In Italian, with English, French and German summaries).

A colorimetric method for residue determination is described for Cidial which is employed in the control of *Carpocapsa pomonella* L. in apples. The procedure involves (a) extraction, with proper solvents, of the insecticide from the oil; (b) separation from water-soluble insecticides (e.g. Rogor) eventually employed with Cidial in order to control other insects; (c) clean-up of the active ingredient by micro-distillation or chromatography from the interfering P compounds; (d) analysis based on P colorimetric determination. P^{32}-labelled ethyl ester of O,O-dimethyldithiophosphoryl-β phenylacetic acid and of its P=O analogue, were used. Details of the thin layer chromatographic method used are given. 0.1 ppm of active ingredient may be estimated with the colorimetric method, 0.3 ppm with the chromatographic one.

II-H-2-c BANANA

722 Bowman, J.S., Gauditz, I., Robbins, A.J. THE USE OF CARBON-14-LABELED MATERIALS AS AN AID IN THE DEVELOPMENT AND UNDERSTANDING OF PESTICIDE CHEMICAL ANALYTICAL TECHNIQUES. 140th Amer. Chem. Soc. Meeting, Chicago, 3-8 Sep. 1961. Paper 31.

By using C^{14}-Zinophos* it was possible to perform a materials balance study on banana extracts and establish the fact that poor recoveries were not due to loss of material but to the presence of interfering agents which inhibited fluorescence measurement. (Cited on p.41 in "Analytical Methods for Pesticides, Plant Growth Regulators, and Food Additives. Vol.I. Principles, Methods, and General Application". Zweig, G., Ed. New York, Academic Press. 1963).

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* O,O-diethyl O-2-pyrazinyl phosphorothioate

II-H-2-d BEANS AND TURNIPS

723 Frehse, H., Niessen, H., Tietz, H. METHODE ZUR BESTIMMUNG VON RÜCKSTÄNDEN DES INSEKTIZIDS LEBAYCID® IN PFLANZLICHEM MATERIAL. (Method of determining residues of the insecticide Lebaycid® in plant material). *Leverkusen. Hofchenbr. Bayer PflSchutz-Nachr.* *15*, 3 (1963) 152-63. (In German).

A procedure is described in detail which allows residue detection (< 0.1 ppm) of the active principle of Lebaycid (fenthion), O,O-dimethyl-O-(methylmercaptophenyl-)thiophosphate (or S 1752, mercaptophos or Bayer 29493), and of its metabolites to be detected in plant tissue. Plant extracts were purified with organic solvents and columns of aluminium oxide or activated charcoal. For a quantitative determination two methods are available, which may be used independently or consecutively: (1) infrared absorption (~7.55 μ) of the S bands obtained from oxidation, and (2) colorimetric microdetermination of P from wet ash. The yield is 80%, and is specific for S 1752-residues which can be identified through infrared absorption in the range from 7-11 μ. P^{32} was used in the necessary quantitative experiments for analyzing residues in beans and turnips.

II-H-2-e COTTON

724 Hacskaylo, J., Lindquist, D.A., Davich, T.B., Morton, H.L. ACCUMULATION OF PHORATE BY COTTON PLANTS FROM SOLUTION AND SAND CULTURE. *Bot. Gaz.* *123* (1961) 46-50.

Cotton seedlings were grown in a nutrient solution containing P^{32}-labelled phorate (O,O-diethyl S-(ethylthio)methyl phosphorodithioate (I). The latter accumulated rapidly in the roots at first (3-4 d) but declined sharply later (7 d). Loss of I from leaves occurred passively via roots into the nutrient solution. Translocation of I from roots to leaves increased with the respiration rate. Subsequent root exposure did not, however, cause additional absorption of insecticide by the plant but, on the contrary, a leakage from roots to nutrient solution. The accumulation of I in leaves of plants grown in sand culture was linearly related to time and was positively affected by conditions favouring transpiration.

725 Shirr, O.E. LOCALE AND METABOLISM OF METHYL PARATHION AND GUTHION IN THE COTTON LEAF. (Abstr. 54). Bull. ent. Soc. Amer. 9, 3 (1963) 163.

The locale of residues of methyl parathion and Guthion on leaves of field cotton was ascertained. Using potted cotton treated with P^{32} labelled methyl parathion or Guthion the phosphorus containing metabolites were determined by radioautographic techniques from benzene or chloroform extracts of the treated leaves.

726 Shipp, O.E., Lindquist, D.A., Brazzel, J.R. CHARACTERISTICS OF RESIDUES OF METHYL PARATHION APPLIED TO FIELD COTTON. J. econ. Ent. 56, 6 (1963) 793-8.

Methyl parathion applied to field cotton by a high-clearance spray machine at the rate of 0.5 lb in 6 gal of water per acre was found to persist on and in the foliage up to 12 d. The principal site of the residues of the insecticide was in and under the cuticle of the leaf and not on the surface. Bioassays indicated the residues of methyl parathion found 1, 3, 7, and 12 d after treatment of the cotton were toxic to the boll weevil (Anthonomus grandis Boheman). Analyses using P^{32}-labelled methyl parathion indicated the residual half-life of the insecticide applied to cotton leaves was approximately 24 h. Maximum penetration of the leaf by the insecticide occurred within the first 2 h after application. The P^{32}-labelled methyl parathion was not translocated from its site of application on the cotton leaf. Locale analyses using radioactive methyl parathion indicated that most of the residual deposit was located within the leaf tissues, with some remaining in the cuticular layer of the leaf. Four compounds containing P^{32} were found in the residue. Two were identified as methyl parathion and methyl para-oxon (dimethyl p-nitrophenyl phosphate) and the others were not identified. Under conditions of high temperatures (72° to 112°F) more of the residual methyl parathion in the cotton leaf was converted to methyl para-oxon than under conditions of lower temperatures (70° to 90° F). The toxicity of the residues of methyl parathion over extended periods was due in part to the presence of methyl para-oxon. (Auth.)

II-H-2-f OLIVE

727 Bazzi, B. DOSAGGIO DEI RESIDUI DI N-MONOMETILAMMIDE DELL'ACIDO O,O-DIMETILDITIOFOSFORILACETICO (ROGOR) IN OLIVE E ORGANI VEGETALI DIVERSI. (Residue determinations in olives and various parts of plants of the N-monomethylamide of O,O-dimethyldithiophosphoryl acetic acid (Rogor)). Italy. Istituto di Ricerche Agrarie. Laboratorio di Signa, Firenze, Montecatini Società Generale per l'Industria Mineraria e Chimica - Milano. 1960. p.3-18. (In Italian, with English, French, and German summaries).

A method is described for the chemical microdetermination in olive fruit of Rogor [S-(methylcarbamyl) methyl-O,O-dimethyldithiophosphate) in the control of the olive fruit fly. The method involves 2 procedures whose adoption depends on the ratio in the extract between the quantity of oily residue and of insecticide. The ratio varies with the physiological stage of the drupes at the moment of analysis and with the operative conditions at the time of insecticide application. The first procedure permits 0.4 ppm determinations of active ingredient, the second 0.05 ppm. The reliability of the latter was established by isotopic dilution technique, using P^{32}-Rogor. Chromatographic, biological and spectrophotometric infra red studies were also carried out on purified extracts.

728 Bazzi, B. DETERMINAZIONE DEI RESIDUI DELL'ESTERE ETILICO DELL'ACIDO O,O-DIETILDITIOFOSFORILACETICO (CIDIAL) NEI PRODOTTI AGRARI. (Determination of residues of the ethyl ester of O,O-dithiophosphorylacetic acid [Cidial] in agricultural products). Chimica 39, 5 (1963) 283-8. (In Italian).

729 Bazzi, B. CONTRIBUTO DELL'ISTITUTO DI RICERCHE AGRARIE DELLA SOC. MONTECATINI ALLA CONOSCENZA DEL METABOLISMO DEGLI ESTERI FOSFORICI INSETTICIDI NEGLI ORGANISMI VEGETALI ED ALLA VALUTAZIONE DEI RESIDUI. (The Agricultural Research Institute of the Society of Montecatini: Data on phosphoric ester insecticides in plants and residue evaluations). Italy. Istituto di Ricerche Agrarie. Montecatini, Società Generale per l'Industria Mineraria e Chimica - Milano. 1963. p.3-23. (In Italian)

The work of the institute is reviewed, particularly on parathion, Rogor and Fac. P^{32}-labelled Rogor was used for studying its metabolism in olives. Methods and results are summarized. The relation between the enzymatic activity of the fruit and the velocity with which Rogor concentration drops are discussed. The P=O derivative formed is more toxic than Rogor and less than parathion. It is formed shortly after administration, rises to a maximum, and then drops gradually. Hydrolysis leads to water-soluble acid compounds, concentration increasing with increasing Rogor degradation. Concentration in oil, and toxicity to mice and rats are discussed. A series of tables deal with such topics as LD_{50} for rats and mice, and the persistence of Rogor and derivatives in (oil) olives from treated trees, oil, (eating) olives, sugar beet, beets, cherries, and peaches.

730 Frehse, H., Niessen, H., Tietz, H. METHODE ZUR BESTIMMUNG VON RÜCKSTÄNDEN DES INSEKTIZIDS LEBAYCID® IN OLIVEN UND OLIVENÖL. (Method of determining residues of the insecticide Lebaycid® in olives and olive oil). Leverkusen Höfchenbr. Bayer PflSchutz-Nachr. 15, 3 (1963) 164-9. (In German).

An extraction process using P^{32}, already utilized in 1959, was further developed in the autumn of 1961. Details of a method are given by which residues of Lebaycid may be determined in olives and olive oil. Residues are enriched, followed by separation from the naturally occurring P-containing compounds in the olive, and the P contained in the molecule of the active principle is subsequently determined by a colorimetric microtechnique.

II-H-2-g SPINACH

731* Klein, A.K., Laug, E.P., Sheehan, J.D., Jr. EXTRACTION PROCEDURES FOR CHLORO-ORGANIC INSECTICIDES. J. Ass. off. agric. Chem., Wash. 42 (1959) 539-44.

In a study in which 3 different sample extraction procedures were compared, C^{14}-methoxychlor was sprayed on spinach plants to determine efficiency of extraction. (Cited on p.41 in "Analytical Methods for Pesticides, Plant Growth Regulators, and Food Additives. Vol.I: Principles, Methods, and General Application". Zweig, G. Ed. New York, Academic Press. 1963).

II-H-2-h WHEAT

732 Lindgren, D.L., Vincent, L.E., Gunther, F.A. BROMINE RESIDUES IN WHEAT AND MILLED WHEAT FRACTIONS FUMIGATED WITH METHYL BROMIDE. J. econ. Ent. 55, 5 (1962) 773-6.

Bromine residues in fumigated wheat and wheat products were analyzed as total inorganic plus organic bromine by instrumental neutron activation analysis. Irradiations were performed in a Triga nuclear reactor: each 5 g sample of wheat was neutron-irradiated for 30 min at a neutron flux of 1.8×10^{12} neutrons/cm^2-sec at a power level of 250 kW; after a 2- to 4-d decay period X-ray spectra were taken with multichannel analyzers. Concentrations of Br in the wheat were calculated by comparing intensities of the 0.77 MeV γ-ray peaks of 36-h Br^{82} in the spectra of the activated samples with those of irradiated Br reference standards. Very little or no loss of Br occurred after aeration for 6 h with either 9% or 15% moisture content wheat. A greater increase in the Br residue occurred with an increase in the moisture content of the wheat or in fumigation temperature. Results indicate that fumigation at lower temperatures and higher dosages may result in lower Br residues than fumigation at higher temperatures and lower dosages. The residue found in wheat fumigated for 48 h was more than 8 x greater than for wheat fumigated for 2 h. A repeat fumigation following a first fumigation by 24 h added 60-70% more Br residue. Regardless of whether the wheat is fumigated and then milled to obtain fractions or whether the fractions are fumigated after milling, the amount of Br residue found was in the following sequence: bran > shorts > flour > middlings.

See also:

510 Studies on the mechanism of fumigants. (Japan. Food Research Inst. Tokyo, 1962)
511 The residue potential of sulfuryl fluoride, methyl bromide, and methane-sulfonyl fluoride in structural fumigations. (Meikle and Stewart, 1962)
519 The spatial distribution of S^{35} and the identity of the tagged compounds in leaves of spinach after treatment with $S^{35}O_2$ gas. (Weigl and Ziegler, 1962)
537 Effect of chlorinated terphenyl on evaporation of γ-BHC. Mode of action of BHC. III. (Ishii and Matsuda, 1959)

552 Residual behavior of O,O-dimethyl S-isopropyl-2-sulfinylethyl phosphorothiolate and its analogues in plants. (Tomizawa, 1963)

564 Metabolic fate of P^{32}-labeled dimethoate in olive fruits and some toxicological implications. (Santi and Giacomelli, 1962)

687 Phorate accumulation by cotton plants and recovery from soil. (Hacskaylo et al., 1961)
Evolution des dépôts superficiels, diffusion et dégradation de deux insecticides endothérapiques: le déméton-S et l'endothion dans quelques plantes maraîchères. (Hascoët, 1963)

1548 Direct elemental analysis of citrus crops by instrumental neutron activation. A rapid method for total bromide, chloride, manganese, sodium and potassium residues. (Castro and Schmitt, 1962)

II-H-3 INSECTICE RESIDUES IN SOIL

733 Gerolt, P. INVESTIGATION INTO THE PROBLEM OF INSECTICIDE SORPTION BY SOILS. Bull. World Hlth Org. 24, 4/5 (1961) 577-91.

Laboratory experiments were carried out to determine the effects of certain factors on the sorption of insecticides by the soils used in the construction of mudhuts; the test insects were adults of Musca domestica L. or Aedes aegypti (L.) and the insecticides were dieldrin, aldrin, DDT or γ BHC. In experiments with thin layers of homogenised mixtures of soil and insecticide, in which no diffusion took place, changes in relative humidity had a pronounced influence on the effectiveness of the insecticide, a 10% increase doubling the toxicity. Tests with DDT labelled with C^{14} showed that humidity was the only factor affecting toxicity. Studies with DDT, dieldrin and radioactive DDT showed that movement of insecticide in the soil was blocked at both very high and very low humidity, and that inward migration occurred only at intermediate humidities. Migration of water in the soil caused the insecticide to move in the same direction. As at a high relative humidity the inward migration of the insecticide is blocked, and as the initial loss in effectiveness by sorption is counterbalanced by the greater availability of the remaining toxicant, the application of the usual field dosage of 0.5 g dieldrin/m^2 remained effective for a considerable length of time. It seems, therefore, that sorption would be a problem in the field only when humidity was low. In the search for means of reducing sorption under dry conditions, promising results were obtained with wettable powders based on ground solidified melts of dieldrin and certain non-sorbable resins. (From auth. summary)

734 Weidhaas, D.E., Schmidt, C.H., Bowman, M.C. LOSS OF PARATHION AND DDT TO SOIL FROM AQUEOUS DISPERSIONS AND VERMICULITE GRANULES. J. econ. Ent. 54, 1 (1961) 175-7.

Both P^{32}-parathion and C^{14}-DDT were strongly adsorbed by soil from water dispersions. From two different volumes of water, the percentage loss of DDT to soil in 24 h was the same (78%), but the loss of parathion with the larger volume was about half (38%) that with the smaller volume. Bioassays of extracts of water and soil with larvae of Anopheles quadrimaculatus Say showed no appreciable loss in toxicity of parathion in 24 h. Tests with marsh water showed that large differences in pH, total solids, and chloride content had little effect on the distribution and codistillation of DDT at 0.02 ppm. Parathion was released into water readily from vermiculite granules; decreasing the concentration of parathion in the granules or increasing the depth and volume of water increased the percentage released at a given time. With vermiculite-DDT granules less than 20% of the DDT was found dispersed in the water at both 2 and 24 h which indicated that it was sloughed off at the time of application. (Auth.)

See also:

512 The degradation of methyl isothiocyanate-S^{35} in various soils. (Kötter et al., 1961)

687 Phorate accumulation by cotton plants and recovery from soil. (Hacskaylo et al., 1961)

II-J Radiomimetic Agents

735 Chamberlain, W.F. ABSORPTION, EXCRETION AND METABOLISM OF P^{32}-LABELED METEPA BY STABLE FLIES AND SCREWWORM FLIES. (Abstr.233). Bull ent. Soc. Amer. 8, 3 (1962) 164.

The feeding or topical application of P^{32}-labelled metepa to stable flies or screwworm flies resulted in preferential absorption by stable flies and a preferential rate of excretion and metabolism by screwworm flies. The only significant metabolic product was phosphoric acid. (Auth.)

736 Plapp, F.W., Jr., Bigley, W.S., Chapman, G.A., Eddy, G.W. METABOLISM OF METAPHOXIDE IN MOSQUITOES, HOUSE FLIES, AND MICE. J. econ. Ent. 55, 5 (1962) 607-13.

The metabolic fate of a P^{32}-labelled sample of the chemosterilant metaphoxide (tris(2-methyl-1-aziridinyl) phosphine oxide) was investigated. In both larvae and adults of the mosquito Culex tarsalis Coquillett, degradation of the chemical was complete within 48 h of administration. Adult houseflies (Musca domestica L.) degraded 50% of large dosages of the chemical within 2 h. The rates of degradation were similar in a susceptible fly strain and in two organophosphate-resistant strains. In mice the observed rate of degradation was about the same as in houseflies. Metaphoxide and one major breakdown product, presumably phosphoric acid, were characterized by paper chromatography from excretory products of both houseflies and mice. (Auth.)

737 Weidhaas, D.E., McDuffie, W.C. HIGHLIGHTS OF RECENT RESEARCH ON CHEMOSTERILANTS FOR THE CONTROL OF INSECTS OF MEDICAL AND VETERINARY IMPORTANCE. Bull. ent. Soc. Amer. 9, 4 (1963) 268-72.

Up-to-date review article. To study the action of the chemosterilant metepa, P^{32}-labelled metepa was applied topically to Musca domestica L. It was rapidly absorbed and degraded. About 50% of the administered dose was absorbed and degraded in 1.5 - 2.0 h. Within 24 h, absorption and degradation were almost complete. Paper chromatographic studies indicated that much of the excreted radioactivity was unmetabolized metepa. More than 90% of the total P^{32} recovered in 24 h was excreted within 8 h of treatment. Similar studies showed that metepa was rapidly absorbed and metabolized in Culex tarsalis and white mice. Degradation of metepa was substantially complete within 48 h after administration to larvae and within 24 h for adults. No degradation appears to be caused by enzymes to other than those responsible for resistance to the organophosphorus compounds. Additional studies showed that P^{32}-labelled metepa was also rapidly absorbed and degraded by the common malaria mosquito Anopheles quadrimaculatus, the yellow-fever mosquito Aëdes aegypti, the screwworm, and the stable fly. The screwworm fly absorbed topically applied metepa only half as rapidly but excreted it twice as fast as the stable fly.

See also:

1172 Some effects of gamma radiation and apholate on the reproductive tissue of Drosophila melanogaster. (Henneberry and Cantwell, 1962)

1180 Preliminary observations on chemosterilization of mosquitoes. (Weidhaas et al., 1961)

1378 Mating ability of male mosquitoes, Aedes aegypti (L.), sterilized chemically or by gamma radiation. (Weidhaas and Schmidt, 1963)

PART II

IONIZING RADIATIONS

I BASIC RESEARCH

I-A Genetic and Cellular Effects

I-A-1 GENERAL ARTICLES. SURVEYS. BOOKS.

738 Anonymous. EFFECT OF NUCLEAR RADIATIONS ON INSECTS. Agric. Res. 2, 2(1962) 81.

Progress report by the Indian Council for Agricultural Research in New Delhi.

739 Астауров, Б.Л. ИОНИЗИРУЮЩИЕ ИЗЛУЧЕНИЯ И НАСЛЕДСТВЕННОСТЬ. ГЕНЕТИЧЕСКАЯ ТЕОРИЯ ЛУЧЕВОГО ПОРАЖЕНИЯ. Природа 4 (1962) 55-67.

Astaurov, B.L. IONIZING RADIATIONS AND HEREDITY. GENETICAL THEORY OF RADIATION DAMAGE. Priroda 4 (1962) 55-67.

Review article. On the basis of data from work on Drosophila melanogaster, Habrobracon, spores of Pteris longifolia, cells of Zyganaema, amoeba Proteus, the alga Acetabeluris, and on females of Bombyx mandarina and males of Bombyx mori, an explanation is attempted of the variety of ways in which the biological effects of radiation manifest themselves. They may range from radiation injury to induced mutations, and are generally treated separately. The author maintains that destruction of vital nuclear structures with accompanying damage to hereditary elements and their role in biosynthesis are the underlying causes of both radiation injury and mutation effects, the actual differences being due to the peculiarities of the particular living system considered. The general radiobiological concept put forward may be called the genetical theory of radiation injury.

740 Астауров, Б.Л. ФУНКЦИОНАЛЬНЫЙ ПРИНЦИП В ОЦЕНКЕ ОТНОСИТЕЛЬНОЙ ЗНАЧИМОСТИ РАДИАЦИОННЫХ ПОРАЖЕНИЙ ЯДРА И ЦИТОПЛАЗМЫ. (ГЕНЕТИЧЕСКАЯ ТЕОРИЯ ЛУЧЕВОЙ БОЛЕЗНИ). Стр. 140-61 в сб. "Труды Московского общества испытателей природы", т.7. 1963.

Astaurov, B.L. FUNCTIONAL APPROACH TO THE EXPLANATION OF THE RELATIVE BIOLOGICAL SIGNIFICANCE OF NUCLEAR VERSUS CYTOPLASMIC RADIATION LESIONS. (Genetic theory of radiation injury.) Trud. mosk. Obshch. Ispyt. Prir. 7 (1963) 140-61.

The relative significance of damage to nucleus and cytoplasm are reviewed in the light of different experimental results. Thus, heavy x-irradiation of the unfertilized egg of Bombyx mori (doses up to 500 000 r) does not prevent normal development, provided the irradiated egg is enucleated and development proceeds androgenetically with a heavily irradiated cytoplasm but with non-irradiated normal male nuclei. As demonstrated by Tultseva and Astaurov (Biophysics USSR, Engl. trans. 3: 1958, 183), triploid embryos of B. mori, for instance, are more resistant to x-radiation than diploid ones. Similarly, tetraploids are still more radioresistant than triploids. Good agreement on the correlation between polyploidy and radiosensitivity are obtained in some microorganisms, in numerous higher plants and in Habrobracon. It is concluded that the various biological effects of radiation are mostly due to initial destructive changes in the genetic elements of cell nuclei accompanied by their disfunction in the processes of constructive biosynthesis.

741 Bacq, Z. M., Alexander, P. "Fundamentals of Radiobiology". Oxford, Pergamon Press. 1961. 555p.

Comprehensive review of the whole field. The chapters on radiomimetic substances and on radiation effects at the cellular level are of particular interest in the present context. Individual insect cells appear to be more radioresistant than comparable individual cells of other organisms.

742 Borstel, R.C. von. EFFECTS OF RADIATION ON GERM CELLS OF INSECTS: DOMINANT LETHALS, GAMETE INACTIVATION AND GONIAL-CELL KILLING. p.367-83 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Review article. Radiations and chemical mutagens kill cells in numerous ways: by one of several kinds of induced dominant lethality, by a direct inactivation of function as with sperm, and by genetically undefinable types of death which may or may not be related to dominant lethality per se. Also, chemical mutagens appear to exert a curious enhancement of the fertilizing capacity of sperm. The different stages of oögenesis and spermatogenesis respond with unequal sensitivity to radiation, and individual cells pass through stages conferring as much as a 50-fold difference in sensitivity. Where species of Diptera, Hymenoptera and Coleoptera can be compared, a striking similarity of response to radiation can be observed, both to stage sensitivity and degree of response with dose. The silkworm, Bombyx mori (Lepidoptera), seems to be similar in most respects to representatives of the other orders in response of germ cells to radiation, but differs sharply in types of dominant lethality induced. Species having atypical genetic mechanisms (e.g., the lecanoid system of Planococcus citri (Hemipt.: Coccidae) are special cases, and their responses to radiation are considerably modified from those of other species. For insect population control by the irradiation-of-male method, dominant lethality is as advantageous in species where matings are multiple as in species where mating occurs once. Sperm inactivation and gonial killing can be regarded as instances of true sterility and are maximally effective only in species where mating occurs once. For most efficient control, doses should be chosen which would induce maximum dominant lethality, minimum sperm inactivation and complete killing of gonial cells. These parameters are simple to determine by gamete viability measurements, irradiated and unirradiated population competition experiments and histological examination of gonia. (Auth.)

743 Davidson, G., Mason, G.F. GENETICS OF MOSQUITOES. Annu. Rev. Ent. 8 (1963) 177-96.

The literature survey was concluded in February 1962. This review article is divided into sections on genetics of insecticide resistance, formal genetics of other characters, and hybridization and speciation. (Some work in which radiation (x-) was used to induce mutants in Culex pipiens molestus, C.p. fatigans, and Anopheles gambiae and to cause sterilization as in Anopheles quadrimaculatus is cited.)

744 Dubinin, N.P. PROBLEMS OF RADIATION GENETICS. "Problemy radiatsionnoĭ genetiki, Moscow, 1961, Gosatomizdat. English Translation (Problems in Radiation Genetics) in AEC-tr-5376, Division of Biology and Medicine, AEC. Nov. 1962. 511p.

The whole field is reviewed. The book is divided into sections on the structural, physical and chemical bases of heredity; the physical nature of the biological action of radiation; the effect of ionizing radiation on heredity of animals, plants, microorganisms and viruses; the action of ultraviolet rays on heredity; the radiogenetic effect of visible light; radiation genetics of mammals; ionizing radiation and human heredity; radiation selection of plants and microorganisms; and concluding remarks. A total of 886 references are given. Results obtained from studies on grasshopper, Drosophila, and others cited.

745 Grosch, D.S. ENTOMOLOGICAL ASPECTS OF RADIATION AS RELATED TO GENETICS AND PHYSIOLOGY. Annu. Rev. Ent. 7 (1962) 81-106.

A comprehensive review article which is divided up into 9 main sections documented by 205 references. The subjects are broken down into gamete production; hatchability (exposure of embryos, exposure of parents); irradiation of larvae and pupae (survival, developmental abnormality); gene mutation; androgenesis; life span of adults (irradiated as adults, irradiation before adulthood); physiological aspects; radioisotope studies; population studies; and tissue culture.

746 Kimball, R.F. REPAIR AND DIFFERENTIAL SENSITIVITY TO MUTATION INDUCTION: SUMMARY AND SYNTHESIS. p.427-41 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Review of findings reported at Leiden 1962 symposium. Periods of mutagenesis, initial lesions, chromosomal aberrations, inactivation and mutation, dose rate and fractionation, and stage sensitivity are discussed. The author comments on the similarity, in diverse organisms, of the patterns of sensitivity for comparable germ cell stages.

747 Kondo, S. THEORETICAL ESTIMATION OF "SURVIVAL CELL NUMBER VERSUS DOSE" CURVE FROM EXPERIMENTAL FREQUENCY DISTRIBUTION OF THE NUMBER OF MUTANTS. Annu. Rep. nat. Inst. Genet., Mishima. 1961 12 (1961) 93-4.

748 Kortschak, H.P. MUTAGENIC EFFECT OF X-RAYS ON MOTHS. Nature, Lond. 196 (1962) 490.

Referring to the paper published by Müller et al., in Nature 194 (1962) 783 (ref. 750), the author disagrees with their interpretation, and states that the increase in mutation frequency for low doses is not less, but very much more than would be expected from the results of irradiation with higher doses.

749* Laven, H. VERERBUNG DURCH KERNGENE UND DAS PROBLEM DER AUSSERKARYOTISCHEN VERERBUNG BEI Culex pipiens. I. KERNVERERBUNG. (Nuclear gene heredity and the problem of extrakaryotic heredity in Culex pipiens. I. Heredity transmitted through the nucleus.)

The possibilities of Culex pipiens for genetic studies are considered, and its biology, breeding, and special techniques to be used are discussed. The need for inducing by irradiation the simple mutations required for such work has led to one particular series of experiments, in which 2-3 d old males were given 4000 r x-rays (42.4 r/min, 169 kV, 7-8 mA, 1 mm Al filter), followed by mating with non-irradiated females. A drop in eggs fertilized and larvae hatched was observed. The first generation showed 2 mutations (theoretically dominant), (Rap, Kpu). Subsequent breeding under specified conditions revealed also some recessive mutations, (var, kps). Radiation-induced and some spontaneous mutations are described. So far, 14 mutations have been isolated, of which 8 derived from x-irradiations, and 6 from spontaneous mutations. Three mutations are dominant, 6 recessive; 3 are sex-linked. Nuclear genes in Culex are transmitted normally, in accordance with Mendelian principles. - Part II, p.478-516 deals with "Ausserkaryotische Vererbung" (extrakaryotic heredity), and an analysis of crossing relations. It is followed by a listing of the literature cited in parts I and II.

750 Müller, I. MUTAGENIC EFFECT OF X-RAYS ON MOTHS. Nature, Lond. 196 (1962) 490-1.

Replying to Kortschak's criticism of his own (M's) deduction concerning the effect of very low doses of x-rays Müller stresses that somewhere between 10 and 20 r there must be a steep increase in mutation-frequency, possibly occurring as a rather sudden step which might imply the existence of a protective mechanism, destroyed by doses between 10 and 20 r.

751 National Inst. of Genetics, Mishima, Japan. ANNUAL REPORT OF THE NATIONAL INSTITUTE OF GENETICS No. 13. NP-13507. 1962. 121p.

Results are summarized from genetic studies in insects, mice, Salmonella, plants, and man. Emphasis was placed on studies on Drosophila, silkworms, wheat, rice, and forest trees. Data are included from studies of mutations induced by x-radiation in Drosophila and silkworm. A list is included of publications during the period. (From NSA 18: 1964, 8046)

752 Norsk Hydro's Inst. for Cancer Research, Oslo. FOURTH REPORT – FOR 1961 AND 1962. NP-13317. 1963. 58p.

Research activities of the Norsk Hydro's Institute for Cancer Research during 1961 and 1962 are summarized. Studies were conducted in the fields of radiobiology, pathology, genetics, biochemistry, and biophysics. A list is included of 122 papers published, or in press, as a result of the research programmes. (From NSA 18: 1964, 1321).

753 Ray-Chaudhuri, S.P. IONIZING RADIATIONS AND THE INDUCTION OF CHROMOSOME MUTATIONS IN THE GERM CELLS. Proc. Indian Sci. Congr. 2 (1961) 154-76.

Review of work done by the author and his associates on males of Gesonula punctifrons. Different sections are devoted to the different types of chromosomal aberrations (metaphase and anaphase abnormalities) induced by x-rays and absorbed P^{32}, and to the chemical protection afforded by sodium azide, versene (ethylenediaminetetraacetic acid), and cysteamine.

754 Russell, W.L. GENETIC HAZARDS OF RADIATION. Proc. Amer. phil. Soc. 107, 1(1963) 11-17.

Includes mutation experiments with Drosophila.

755 Saint Louis University. SPONTANEOUS AND RADIATION MUTAGENESIS AND MUTABILITY IN Drosophila. FINAL REPORT JUNE 1, 1962-MAY 31, 1963. TID-19622. 1963. 18p.

Progress is reported in studies on the transgeneration transmission of nutrients through the egg or sperm of Drosophila, the effect of various nutrients in the growth medium on mutation rate in Drosophila, nonrandom assortment of nonhomologous chromosome elements in male D. melanogaster, and chromosome arrangement in mature sperm of Drosophila. (NSA 18: 1964, 1322).

756 Wolff, S. RADIATION GENETICS. p. 419-75 in "Mechanisms in Radiobiology. Vol. I. General Principles". Errera, M., Forssberg, A., Eds. New York, Academic Press. 1961.

Review article. It aims to give an elementary background to the problems and theories in radiation genetics. Drosophila data are cited freely. The author discusses the types (intra- and intergenic) genetic effects; the effect of slow neutrons; the induction of mutations by cosmic and other natural radiations; gene size from target theory; dominant lethals; genetic effects of ultraviolet radiation; modification of x-ray-induced mutagenesis; the oxygen effect; and the effects of polyploidy on radiation-induced mutagenesis. 168 references cover relevant literature from 1927-1959.

See also:

1201 Cytological effects. (Tahmisian, 1961).

I-A-2 DOMINANT LETHALITY. STERILITY. CELL KILLING

757 Абелева, Э.А., Лапкин, Ю.А. О ЗАВИСИМОСТИ ЧАСТОТЫ ВОЗНИКНОВЕНИЯ ДОМИНАНТНЫХ ЛЕТАЛЬНЫХ МУТАЦИЙ В СПЕРМАТИДАХ ДРОЗОФИЛЫ ОТ ДОЗЫ ОБЛУЧЕНИЯ БЫСТРЫМИ НЕЙТРОНАМИ. Радиобиология 2, 2 (1962) 293-7.

Abeleva, E.A., Lapkin, Yu.A. DEPENDENCE OF THE FREQUENCY OF OCCURRENCE OF DOMINANT LETHAL MUTATIONS IN THE SPERMATIDS OF Drosophila UPON DOSE OF IRRADIATION WITH FAST NEUTRONS. Radiobiology 2, 2(1962) 181-7. AEC-tr-5429, March 1963. Translation from Radiobiologiya 2, 2(1962) 293-7.

The frequency of occurrence of dominant lethal mutations in spermatozoa of Drosophila subjected to fast-neutron doses from 600 to 2400 rads was found to be directly proportional to the radiation dose. In spermatids, the frequency of mutations for the range from 600 to 1200 rads on the dose curve was also found to be proportional to the dose, while it lagged considerably behind a linear dependence on dose over the range from 1200 to 2400 rads. In spermatids, the character of the dose-dependence of dominant and recessive lethal mutations induced by γ-rays, x-rays and fast neutrons was completely analogous. The RBE of neutrons in the case of spermatozoa is approximately 3 times greater than that of γ-rays, whereas in spermatids the neutron RBE is only 1.5 times higher. The radiosensitivity of spermatozoa to fast neutrons was found to approach that of spermatids. (From auth. conclusions).

758* Alexander, M.L. THE EFFECTS OF RADIATIONS ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSIOLOGICAL AND BIOCHEMICAL SYSTEMS. Progress Report, May 1, 1958-April 30, 1959. TID-17001, Texas. Univ., Houston. M.D. Anderson Hospital and Tumor Inst. 24p.

Still using the developing germ cells of Drosophila virilis the variations in radiosensitivity of non-dividing cells were shown to depend both on differences in sensitivity of the chromosomes for breakage and differences in enhancement of biological damage from environmental changes. A differential action upon cells in division and non-dividing cells was shown. Preliminary studies indicate that several lethal actions resulting from treatment of dividing cells can be separated and tested with the various radiations. Data are included on the effects of radiations from fission neutrons, accelerator neutrons, therapy x-rays, γ-rays, and 22-MV x-rays from a betatron accelerator. Germ cells of varying sensitivities were exposed in an atmosphere of O_2 or N_2. Data are presented graphically. Results are included from a study of mutation rates at specific gene loci in mature sperm and spermatogonial cells of D. melanogaster. (From NSA 17: 1962, 1237).

759* Alexander, M.L. THE EFFECTS OF RADIATIONS ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSIOLOGICAL AND BIOCHEMICAL SYSTEMS. Progress Report, May 1, 1959-April 30, 1960. TID-17002, Texas. Univ., Houston. M.D. Anderson Hospital and Tumor Inst. 20p.

Further results are reported from studies on the effects of radiation dose rates on genetic damage in mature sperm and various types of germ cells of the spermatogenic cycle in Drosophila virilis. Tests were made for genetic mutations at specific gene loci in sperm and spermatogonial cells. Differences in radiation damage after treatment of mature germ cells and premeiotic spermatogonial cells are discussed.

760 Alexander, M.L. THE EFFECTS OF RADIATIONS ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSIOLOGICAL AND BIOCHEMICAL SYSTEMS. Progress Report, May 1, 1960-April 30, 1961. TID-17003, Texas. Univ., Houston. M.D. Anderson Hospital and Tumor Inst. 15p.

Results are reported of experimental tests for recovery systems that act after radiobiological damage, and of studies on the types of genetic damage induced and the recovery of mutational types of damage from spermatogonial cells of Drosophila virilis. Dose rate studies with γ-rays in anoxic and oxygenated atmospheres were employed in investigations of post-irradiation methods for reducing genetic damage. Higher values for dominant lethals were recovered from spermatogonia after irradiations with 22-MV x-rays than with 200-kV x-rays. Investigations were made of chromosome breakage, cell degeneration, genetic damage, and mutational studies of sex-linked and autosomal loci. Direct comparisons were made of loci on the sex chromosome and the autosomal loci in sperm and spermatogonial cells. (From NSA 16: 1962, 1239).

761 Андреев, С.В., Мартенс, Б.К., Молчанова, В.А., Степанов, А.С. ИССЛЕДОВАНИЕ ВЛИЯНИЯ ДОЗЫ ОБЛУЧЕНИЯ НА СМЕРТНОСТЬ И ПОЛОВУЮ СТЕРИЛИЗАЦИЮ АМБАРНОГО ДОЛГОНОСИКА. Радиобиология 2, 5 (1962) 758-62.

Andreev, S.V., Martens, B.K., Molchanova, V.A., Stepanov, A.S. STUDY OF THE DOSE-DEPENDENCE ON THE SURVIVAL RATE AND THE SEXUAL STERILIZATION OF THE GRANARY WEEVIL (Calandra granaria). Radiobiologiya 2, 5 (1962) 758-62.

In order to determine the lowest industrially usable dose, studies were carried out on the mortality, sterility, and the reduction of the biological activity of the granary weevil. A 50 g equivalent Ra-Co^{60} source was used for the tests, regulating the dose by adjusting the distance. Groups of insects were exposed to 0 r, 1, 8, 12, 20 and kr of radiation. The results have indicated that exposure to doses between 0.5 and 1 kr exerts partial lethal and sterilizing action; complete sterilization is reached at about 8 kr. (From NSA 17: 1963, 6368).

762 Baldwin, W.F. RADIATION INDUCED STERILITY IN Rhodnius prolixus. p. 8 in "Radiation Biology in Canada 1962-63". CRB-1129, AECL-1701, Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 1963. 60p.

The doses of x-irradiation required to sterilize R. prolixus in the nymphal and adult state and the effects of this sterility in limiting the growth of laboratory-reared populations is being investigated. (Auth.)

763 Baldwin, W.F., Shaver, E.L. RADIATION-INDUCED STERILITY IN THE INSECT Rhodnius prolixus. Canad. J. Zool. 41 (1963) 637-48.

Immature 5th instar Rhodnius nymphs and adults of both sexes were exposed to various doses of 2 MVP x-rays, chosen to produce reductions in fertility up to and including complete sterility. In male insects irradiated as 5th instar nymphs and reared to the adult stage, sterilizing doses interfered with mating, thus making these males useless as a means of inhibiting the growth of populations into which they are introduced. Exposure in the adult stage, on the other hand, had less effect on mating behaviour. Thus, with a very high dose (17 500 r) and high ratios of sterile to fertile males, a substantial reduction occurred in percentage of viable eggs from normal females. However, this was true for the 1st month only. In the 2nd and 3rd months, the effect on population fertility disappeared, a result of the early deaths of irradiated males. Greater effectiveness in limiting population growth over extended periods might be expected to result from the introduction of males that had been partially sterilized by exposure to lower doses. (Auth.)

764* Bateman, A.J., Chandley, A.C. EFFECTS OF X-RAYS ON FEMALE GERM-CELLS OF Drosophila melanogaster. I. DOMINANT LETHAL MUTATION AND OVIPOSITION IN RELATION TO TREATED STAGE. Int. J. Rad. Biol. 7, 4(1963) 385-94.

The sensitivity in terms of dominant-lethal induction (strictly speaking: reduced hatchability) has been measured for successive eggs laid by D. melanogaster after irradiation of the female with 1000, 4000 and 6000 rad.

Hypersensitivity is found in eggs laid by females aged 7 d, during the first 12 h after irradiation. This is attributed to irradiation of Metaphase I. A lower level of sensitivity is found in eggs laid over the next six days. This is attributed to the irradiation of oöcytes in all stages prior to Metaphase I. Finally, a residual incidence of dominant lethals is observed in eggs laid more than 6 d after irradiation, which are presumed to have been irradiated as oögonia. Oviposition (i.e. rate of maturation of eggs) shows an entirely different radiation response. 4000 rad produces a slight depression of egg-laying during the period of low dominant-lethal production, a more marked depression coinciding with the main production of dominant lethals, and a particularly severe depression on day 3 after irradiation. The pattern of sensitivity after 6000 rad is the same but more marked. The egg-laying rate more than 6 d after irradiation is slightly depressed by 4000 rad, and more so with increasing doses until 10 000 rad, when complete sterility is produced. After such a dose the ovarioles are atrophied, without oöcytes or oögonia. (Auth.)

765 Bletchly, J.D. EFFECTS ON SUBSEQUENT GENERATIONS AFTER γ-IRRADIATION OF LARVAE OF Lyctus brunneus (STEPH.) (COLEOPTERA, LYCTIDAE). Ann. appl. Biol. 50 (1962) 661-7.

The effects of a single irradiation at 4000 r on larvae of the powder-post beetle L. brunneus (Steph.) are described. These included a reduced and delayed emergence of the 1st generation. The number of beetles produced per female returned to normal in subsequent generations. The vigour of emerged beetles as judged by their average weights did not appear to be much affected. Irradiation at a sublethal dosage thus seems unlikely to be a practical method of employing γ-radiation for the treatment of infestations by wood-boring insects. One of the chief limiting factors in the employment of lethal dosages for such treatments is the mass of screening required, hence a technique enabling lower dosages to be used would be of value. (Auth. summary)

766 Boroughs, H. THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual report. p.50-7 in TID-15341, Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica, 1 Mar. 1962 59p.

Work by K.P. Katiyar, J. Valerio and E. Ortiz on Ceratitis capitata (Wied.) is described, which includes moderately successful mass breeding studies. A Cs^{137} source (γ-field) was used, a new Co^{60} source (allowing greater precision) being expected. - Pupae (8-d) were irradiated at 1000 r/min and mated with non-irradiated females. Egg production and fertility were investigated over the range 4-13 kr. Male fertility decreased with increasing dose, some fertility still remaining at 13 kr. -P^{32}-labelled flies were produced for dispersal studies. After only 24 h access to labelled honey solution (3.8 μc/ml) adults remained identifiable even beyond 4 weeks. The biological loss of P^{32} from adults labelled either as larvae or adults is shown. Adult feeding is less expensive and equally effective. The distribution (maximum in thorax - ingestion ?; minimum in wings) is tabulated for different stages. Records are based on 10 individuals, both sexes, for concentrations of 1.0 μc P^{32}/g larval medium, and 75 μc P^{32}/20 ml honey water solution. Experiments with Sr^{89} yielded insufficient radioactivity, Sr^{89} remaining in the pupal skin. -In addition to γ-irradiation, radiomimetic substances are being tried for inducing sterility.

767 Borstel, R.C. von. INDUCTION OF NUCLEAR DAMAGE BY IONIZING AND ULTRA-VIOLET RADIATION. p.243-50 in "Progress in Photobiology. Proceedings of 3rd International Congress on Photobiology. The Finsen Memorial Congress, Copenhagen, 1960". Amsterdam, Elsevier Publishing Company. 1961.

The study of irradiated, unfertilized Habrobracon eggs was combined with the study of irradiated eggs fertilized by unirradiated sperm to detect different kinds of nuclear damage. Damage is used in the sense of induction of death of the cell either immediately after irradiation or after few or many mitoses occur. Types I to V lethality were studied and the probable cause of each was determined. During the study on the comparison of ultraviolet and ionizing radiation effects on the nucleus, it was concluded that ultraviolet radiation has a quantitatively different response than x-radiation. Discussion is included on the different effects of the two types of irradiation. (From NSA 16; 1962, 1621.)

768 Bull, J.O., Wond, T., Cornwell, P.B. A COMPARISON OF THE SUSCEPTIBILITY OF THE GRAIN WEEVIL (Sitophilus granarius L.) TO ACCELERATED ELECTRONS AND ^{60}Co GAMMA RADIATION. AERE-R-3890, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1961. 45p.

No difference could be detected in the numbers of emerged adults, rate of emergence or stage at death in the grain when two types of infested wheat, English and Manitoba, containing mostly pupae, were treated with γ-radiation and accelerated electrons. Mature adults were more susceptible to the killing and sterilizing effects of γ-radiation. The estimated LD$_{50}$ was about 3000 rads higher for accelerated electrons than for γ-rays, the estimated dose for 50% reduction in progeny about 600 rads higher. The difference in dose for 99.9% mortality and sterility was about 5000 rads. Possible explanations of the

observed results are discussed. The likelihood of grain weevils providing a useful biological dosimeter in engineering studies for radiation disinfestation of grain holds little promise.

769* Carson, G.L., Braver, G. STUDIES OF THE SPOUSE EFFECT ON SPONTANEOUS AND X-RAY INDUCED LETHAL MUTATIONS IN Drosophila melanogaster. p.44 in "Proceedings of 10th International Congress of Genetics, McGill University, Montreal, 20-27 August 1958. Vol.II". Toronto, University of Toronto Press. 1958.

770 Chandley, A.C. THE INDUCTION OF MUTATIONS IN SPERMATOCYTES OF Drosophila melanogaster WITH X-RAYS. Int. J. Rad. Biol. 5, 4 (1962) 305-22.

F$_1$ males of D. melanogaster were irradiated with 1000 rads x-rays and mated 2♀/♂/d for 8d. Frequencies of dominant lethals, translocations, sex-linked lethals, deleted X's and induced crossing-over in the male were estimated for matings on d 5, 6, 7 and 8 following treatment. It is claimed that the sperm used in matings over these 4 sampling days was in the spermatocyte or early spermatid stage at the time of irradiation. Thus the frequencies of mutations recorded give an estimate of the relative sensitivities of these various stages of germ cell development to x-rays. Results show that sex-linked lethals and translocations follow similar patterns, reaching a peak on d 5, the level then dropping off through d 6 and 7 to a low value on d 8. Dominant lethals show an increase from d 5 to a high level on d 6 which is maintained over d 7 and 8. Deleted X's and induced crossing-over increase from d 5 through d 6 and 7 to reach a peak on d 8. The relationship between the type of aberration studied and the sensitivity pattern of the treated germ-cells is discussed. (From auth.)

771 Clayton, F.E. DEVELOPMENTAL-GENETIC STUDY OF THE EFFECT OF X-RAY IRRADIATION IN Drosophila virilis AND Bufo valliceps. Final Scientific Report, Jan.1, 1955- Dec.31, 1960. ORO-373, Arkansas. Univ., Fayetteville. 1 Mar. 1961. 115p.

Normal spermatogenesis in D. virilis was studied by examining living cells by phase-contrast microscopy. Primary spermatocytes occurred in cysts of 8 cells. Histological analysis of sections from adult males indicated a 2d-cycle in meiosis until the males are sexually mature at 6 d. Following the 6th d the number of immature cells in the testes decreased steadily without further peaks in the number of primary spermatocytes on alternate days. Spermatozoa were not motile and functional until the 6th d. Typical configurations of chromosomes during spermatogenesis are presented. Results are included from a series of tests to determine the effects of irradiation on D. virilis males as measured by dominant lethal and translocation rates in cells at various stages of spermatogenesis and sperm differentiation. Males at different ages were irradiated under similar conditions and mated with mature virgin females within 1 h after irradiation and left for 5 d. No fertile eggs were deposited; the males were then remated to mature virgin females and daily egg counts made. After a 2 d-mating period, the males were remated and egg counts made. This procedure was continued for a total of 8 consecutive mating periods. Data are tabulated on rates of dominant lethals resulting from irradiation during various stages of spermatogenesis. (From NSA 15; 1961, 14119).

772 Crook, L.J. THE SUSCEPTIBILITY OF THE RUST-RED FLOUR BEETLE, Tribolium castaneum (Herbst.) TO GAMMA RADIATION. AERE-R-3889, United Kingdom Atomic Energy Authority, Research Group. Isotope Research Div., Wantage, Berks, England. 1962. 19p.

All developmental stages of the rust-red flour beetle, T. castaneum, were treated at 30° C by γ-radiation from Co^{60} with doses varying from 1000-19 200 rads, at a dose rate of 4000 rads/h. Development of adults from irradiated eggs and larvae was completely prevented by 11 200 rads. About 90% of adults emerged from pupae irradiated at 16 000 rads but only 3% survived. A 50% kill of eggs was obtained by 5000 rads, of larvae by 4700 rads, of pupae by 10 500 rads and of adults by 13 200 rads. Only 1% of adults remained alive after treatment with 19 200 rads. A 99.9% reduction in progeny was obtained after treatment of eggs, larvae and pupae with doses in excess of 8600 rads. Very slight fertility was observed in adults treated at 11 200 rads. No recovery of fertility was detected after the irradiation of any developmental stage. All developmental stages of T. castaneum are more resistant to radiation than T. confusum. T. castaneum is also more resistant than Sitophilus granarius except in the susceptibility of adults to sterilization. The dose evaluated for control of S. granarius (16 000 rads) produces complete sterilization of T. castaneum, but allows 10% of the sterilized adults to survive. (Auth. summary).

773* Dal Monte, G. UTILIZATIONE DEI RAGGI IONIZANTI PER LA CONSERVAZIONE DEI CEREALI. (The use of ionizing radiation in the preservation of cereal products). Molini d'Italia 10, 1(1959) 29-33. (In Italian).

The section of the Conference on the Preservation of Foodstuffs by Ionizing Radiation (arranged by the FAO at the UKEA in Harwell, November 17-21, 1958), which was devoted to the disinfection and pest control of cereal products, is summarized. The behaviour of single species was investigated, and it was found that 6000 rep γ-radiation destroyed corn and rice weevils (Calandra granaria and C. oryzae, respectively) in 20 d and flour beetles (Tribolium castaneum) in 36 d after irradiation. At this level of radiation, no harmful chemical or organoleptic changes could be found. The second part of the report deals with economic aspects of pest control.

774 Davich, T.B., Lindquist, D.A. EXPLORATORY STUDIES ON GAMMA RADIATION FOR THE STERILIZATION OF THE BOLL WEEVIL. J. econ. Ent. 55, 2(1962) 164-7.

The effect of γ-radiation on boll weevil (Anthonomus grandis Boheman) adults, pupae, and eggs was determined following exposure to Co^{60}. Longevity and egg-laying capacity of reproducing weevils were drastically reduced at doses of 5000 r or higher, whereas egg hatch was greatly reduced at doses as low as 2500 r. Exposure of virgin males to 10 000 r resulted in transient sterility whereas 15 000 r produced permanent sterility. However, these doses resulted in very rapid mortality of both sexes. A ratio of 3.8 : 1 : 1 of sterilized males : normal males : normal females did not affect egg laying or hatch. There appeared to be little, if any, effect of adult boll weevil age on susceptibility to the lethal effects of γ-rays. Emergence of adults from prepupae, young, and old pupae exposed to 10000 r was eliminated, greatly reduced, and unaffected, respectively. However, the lethal effects carried over because all of the adults died within 2 weeks. Exposure of eggs to 600 r did not affect hatch or subsequent development whereas 2400 r drastically reduced hatch and prevented subsequent development. (Auth.)

775 De Bach, P., White, E.B. IRRADIATED PARASITIC WASPS, THE EFFECT ON PROGENY PRODUCTION AND SEX RATIO. J. Hered. 53, 6(1963) 271-6.

Irradiation of adult Aphytis lingnanensis Comp. at dosages of 250, 500, 1000, 2000, and 4000 r produced: (1) no effect on longevity of the treated adults; (2) pronounced reduction in net fecundity with increasing x-ray dosage; (3) indications that mature eggs were less affected by x-ray treatment than the less mature ones; and (4) sharply reduced percentage of females in the progeny of those individuals which received the highest dosages. (BA 44: 1963, 254)

775-a De Fries, J.C., Touchberry, R.W. GENETIC EFFECTS OF RADIATION ON EGG PRODUCTION OF Drosophila melanogaster. (Abstr.) Genetics 47, 8 (1962) 950.

Studies were initiated by the authors to assess the genetic effects of radiation on biometrical traits. Both newly emerged males and females from Luces's wild-type strain were subjected to various dosages of γ-irradiation (0, 500, 1000 and 1500 r) and mated in all possible combinations, resulting in a four × four factorial arrangement of treatments. Three mating pairs were included in each subclass of two identical experiments, requiring a total of 48 mating pairs per generation. Mean daily egg production over a 10-d period of the treated females (generation one), their progeny (generation 2), and offspring (generation 3) resulting from a full-sib mating of generation two was obtained in both experiments. Somatic effects would be expressed in generation 1 whereas genetic effects would be expressed in generations 2 and 3. The significance of the linear and quadratic main effects of treatment on males and females, as well as the various interactions, were determined by orthogonal comparisons. In general, the results support previous evidence found by the authors that radiation-induced polygenic damage in surviving offspring is not large. (From abstr.)

776 Dickerman, R.C. THE INDUCTION OF DOMINANT LETHAL MUTATIONS IN x-IRRADIATED Drosophila virilis OÖCYTES. Diss. Abstr. 23, 5 (1962) 1492-3.

To study the effect of various gases and combinations of gases on the induction of dominant lethal mutations in x-irradiated D. virilis oöcytes two stages of oöcytes were used. Females containing stage 7 oöcytes were irradiated with 2000 r and females containing stage 14 oöcytes were irradiated with 250 r. The flies were irradiated in the presence of 1 or 10 atmospheres (atm) of argon, He, methane, CO, air, O_2, or combinations of 9 atm of argon, He, or methane plus 1 atm of O_2. The percentage non-hatch was attributed to the induction of dominant lethal mutations. It was found that the LD_{50} of mature oöcytes (stage 14) irradiated in air is about 350 r while the LD_{50} for stage 7 oöcytes irradiated in air is about 2000 r. This demonstrated that stage 14 oöcytes are much more sensitive to radiation damage than stage 7. Stages 7 or 14 oöcytes were irradiated in conditions of increased oxygen tension (10 atm air, 1 or 10 atm of O_2). The groups showed an increased induction of dominant lethals as scored by percentage non-hatch, when compared to oöcytes irradiated in one atmosphere of air. Stage 7 or 14 oöcytes irradiated in the presence of 9 atm of argon, He, or methane with 1 atm of oxygen showed a large decrease in induced dominant lethals when compared to oöcytes irradiated in 1 atm of pure O_2. This demonstrates that argon, He, and methane have a protective effect against the induction of dominant lethal mutations. Stage 7 or 14 oöcytes irradiated in the absence of oxygen (presence of 1 or 10 atm of argon, He, methane, or CO) showed a large decrease in the induction of dominant lethal mutations when compared to oöcytes irradiated in 1 atm of air, thus showing that decreased O_2 in the oöcyte leads to decreased damage to the cell. Fewer dominant lethals were induced when the oöcytes were irradiated in 10 atm of argon, He, methane, or CO as compared to oöcytes irradiated in one atmosphere of the same gas. In preliminary investigations stage 7 oöcytes were irradiated in the presence of 10 atm of carbon monoxide with fractionated doses. A slight increase in the percentage hatch of the groups irradiated in two fractions as compared to the groups irradiated in one dose was observed. The differences in percentage hatch of the groups irradiated in fractionated doses were not statistically significant. Tentative evidence was presented that indicates that anoxia during fractionated doses or irradiation in stage 7 oöcytes does not increase the frequency of induced dominant lethal mutations. The work was subsequently published in Genetics 48 (1963) 311-9.

777 Dickerman, C. INDUCTION OF DOMINANT LETHAL MUTATIONS IN X-IRRADIATED Drosophila virilis OÖCYTES. Genetics 48 (1963) 311-9.

For abstract, see 776.

778 Erdman, H.E. EFFECTS OF IRRADIATING SINGLE AND MIXED SPECIES OF BEETLES. p. 198-201 in "Hanford Biology Research Annual Report for 1960". HW-76000, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 10 Jan. 1961.

Effects on reproductive abilities, induced dominant lethals, and life spans were investigated for single- and mixed-species cultures of flour beetles, T. confusum and T. castaneum, given x-radiation. T. castaneum was more x-ray tolerant. Co-existence as well as 2 kr x-radiation reduced T. confusum progeny. (Auth.)

779 Erdman, H.E. X-RAY TOLERANCE OF TWO RELATED SPECIES OF BEETLES. p. 156-9 in "Hanford Biology Research Annual Report for 1961." HW-72500, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 15 Jan. 1962.

Sterilizing and lethal x-ray doses were determined for various developmental stages of Tribolium confusum and T. castaneum. Under the experimental conditions, T. castaneum was more x-ray resistant than T. confusum. Radiotolerance of both species increased as development and differentiation progressed; the 1-3h oviposited egg was the most sensitive stage. (Auth.)

780 Ghosh, S.M., Hati, A.K., Basu, S.P. EFFECT OF GAMMA RADIATION ON THE FERTILITY OF Aedes aegypti. Bull. Calcutta Sch. trop. Med. Hyg. 9, 3 (1961) 111.

Exposure of adults of Aedes aegypti (L.) to γ-radiation in doses from 500 r up to 2000 r, in steps of 500 r, had no effects on longevity, feeding or mating habits. Exposure to 6000 r, the highest dose used, did not sterilize females or lessen their readiness to mate, though it did so with the males, and the few eggs that resulted from the mating of such males with normal or irradiated females failed to hatch. Half the eggs exposed to 2000 r were killed and development of the larvae delayed. Whereas eggs hatched and larvae developed normally after 1000 r, 3000 r killed almost all eggs. It is concluded that males of A. aegypti required a much lower dose of γ-ray exposure for sterilization than females, and that eggs can be killed by exposure between 2000 r and 3000 r.

781 Gómez, N.J.C., Fernández, M.J., Gallimore, J.C., Gross, A. EL EFECTO DE LAS RADIACIONES IONIZANTES SOBRE LA BIOLOGIA Y LA ECOLOGIA DEL Rhodnius prolixus, VECTOR PRINCIPAL DE S. cruzi EN VENEZUELA. p. 185-93 in "4th Inter-American Symposium on the Peaceful Application of Nuclear Energy, Mexico City, 9-13 April 1962". Washington, D.C. Pan American Union, 1962.

See 782.

782 Gómez, N.J.C., Gallimore, J.C., Fernández, M.J., Gross, A. THE EFFECT OF IONIZING RADIATION ON THE BIOLOGY AND ECOLOGY OF Rhodnius prolixus, THE PRINCIPAL VECTOR OF Schizotrypanum (i.e. Trypanosoma) cruzi IN VENEZUELA. Acta cient. venez. 13, 2 (1962) 46-52. (In Spanish, with English summary).

Ionizing radiations in the systematic and detailed study of Rhodnius prolixus are discussed. Sterilization occurred when males were subjected to doses > 10 000 r; motility and longevity were significantly reduced by 10 000 r and 40 000 r respectively. In progeny from irradiated males mutations were found which prevented normal development of the nymphs. The use of irradiated males also served to establish the absence of a "copulatory stoppage" in the female. Co^{60} was used for labelling in ecological studies, which showed the distribution in and outside houses. The results suggest changes in the concepts held to date on the behaviour of this vector in Venezuela.

783 Henneberry, T.J. EFFECTS OF GAMMA RADIATION ON THE FERTILITY AND LONGEVITY OF Drosophila melanogaster. J. econ. Ent. 56, 3 (1963) 279-81.

Untreated females of D. melanogaster Meigen mated with males exposed to 4 kr of γ-radiation in the larval, and 16 kr in the pupal or adult stage deposited the normal number of eggs, none of which hatched. Females irradiated in the pupal or adult stage with 8 or 16 kr and mated with untreated males produced few or no eggs. Females irradiated in the larval stage produced fewer eggs after exposure to high doses of gamma radiation than untreated females but showed no reduction in the percentage of emerging adults. The longevity of males or females exposed in the pupal or adult stage was not affected by the radiation treatment. Males and females irradiated in the larval stage were shorter lived than untreated insects. Untreated female flies mated with irradiated males (16 kr) produced sterile eggs, but when mated a second time with untreated males, produced viable eggs. Untreated female flies mated with normal males produced viable eggs, but when subsequently mated with irradiated males, they continued to produce viable eggs. Sterile males confined with normal males and females reduced the number of progeny. (Auth.)

784 Henneberry, T.J., McGovern, W.L. SOME EFFECTS OF GAMMA RADIATION ON FERTILITY OF Drosophila melanogaster AND VIABILITY OF SPERM AFTER MULTIPLE MATINGS OF MALES. J. econ. Ent. 56, 5(1963) 819-22.

Untreated D. melanogaster Meigen females mated to males exposed to 16 kr of γ-radiation in the pupal or adult stage produced as many eggs as untreated females mated to untreated males, but few or no adults emerged. Females exposed to 16 kr during the pupal or adult stage and mated to untreated males produced no eggs. When males and females were treated with 16 kr as 1-, 5-, or 10-d-old adults and mated immediately after treatment, normal numbers of eggs were produced but very few adults emerged, except for females treated when 10 d old, which produced a significantly larger number of eggs than females treated at 1 and 5 d of age. When 1-, 5-, or 10-d old males were irradiated with 16 kr and mated 1 or 6 d after treatment to untreated females, normal numbers of eggs were produced, but again few or no adults emerged, an indication that restoration of damaged sperm did not occur. When males exposed to 8 or 16 kr were individually furnished a series of untreated virgin females within an 8-h period on the same day of treatment and 5 and 10 d after treatment, the females laid fairly normal numbers of eggs, but 99% of these eggs were sterile. Fewer eggs were deposited by the 4th and 5th untreated females in each series than by the 1st and 2nd females. (Auth.)

785 Hoenigsberg, H.F., Pozzi, L.V., Sironi, G.P. THE RESPONSE OF Drosophila TESTIS TO X-RAY INDUCTION OF DOMINANT LETHALS. Atti. Ass. genet. ital. 6 (1961) 261-76. (In English).

Data presented suggest 1) that to call a 3-d batch of sperm of D. melanogaster (as done in dosage-frequency experiments) an homogeneous sample is erroneous since it contains a mixture of sperm cells which "die" differently; 2) that a 9-d sensitivity spectrum includes all stages from mature spermatozoa to spermatocytes, whereas the highest sensitivity to x-rays is localized in the meiotic stage; and 3) that in the O$_2$-effect 2 processes work independently from each other; one causing an increase in chromosome breaks, the other affecting the amount of rejoining of breaks.

786 Hoopingarner, R., Kumararaj, S., French, A. GAMETOGENESIS AND RADIATION RESPONSE IN THE CEREAL LEAF BEETLE. (Abstr. 293) Bull. ent. Soc. Amer. 9, 3(1963) 175.

Gametogenesis in both male and female cereal leaf beetles, Oulema melanopa (L.), shows considerable meiotic activity in all stages of adult development. Feulgen-DNA stains were used to trace development. Beetles were subjected to x-rays to produce dominant lethal sterility.

787 Ives, P.T. GENETIC AND DIRECT EFFECTS OF GAMMA RADIATION ON Drosophila. (Abstr. 81D387) p. 46-7 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

During the year we completed work on the X-mutation rate-γ dose relationship after 1/4, 1/2 and 1 kr, testing daily sperm samples, days 1-12, at 25°C. The relationship is linear except that 1/4 kr gives the same rate as 1 kr and higher than 1/2 kr in days 9-10 sperm dropping to the linear level in days 11-12. Possibly germinal selection is delayed until day 11 at 1/4 kr. The control rate is constant for all days. – ♂♂ raised and kept at 20° or 15° show peak mutation rates, after 1 kr, in sperm deposited as much later after irradiation as development was longer at those temperatures, proving that the level of mutation response is "stage specific" in spermatogenesis, not "time specific" after irradiation. There was variation by a factor of 2 between series of tests at 15°C. – Studies on induced chromosomal changes showed 35% lethality, probably position effect, associated with each translocation break, but none associated with crossovers, in ♂♂. – Current studies are on (1) Variation in mutagenic response to radiation in 15° C tests, (2) Lethality associated with induced autosomal inversions, and (3) Possible synchronized responses to radiation (simultaneous crossovers in chromosomes 2 and 3) in premeiotic spermatogenic stages.

788 Kaneko, A., Shima, T., Momma, E. DOMINANT LETHALS INDUCED IN DROSOPHILA VIRILIS THROUGH IRRADIATION OF GERM-CELLS. (Abstr.) Jap. J. Genet. 37 (1962) 392. (In Japanese).

789 Kansu, A. PRELIMINARY EXPERIMENTS ON THE STERILIZATION OF THE PUPAE OF THE KHAPRA BEETLE BY IRRADIATION WITH GAMMA RAYS. Z. angew. Ent. 49, 2 (1962) 224-8.

Tests on the sterilization of Trogoderma granarium Everts, which has become a serious pest of stored grain in Turkey, were carried out by exposing the pupae to γ-rays from Ir^{192}. Doses of 6000 r or more reduced reproductive capacity when applied to 1-d-old male pupae, and 15 000 r, the highest dose applied, resulted in the sterilization of all the males in 2 out of 3 tests. Doses of up to 7500 r applied to female pupae had no effect on reproductive capacity. Further tests indicated that the effects become more apparent in the 2nd generation after irradiation. Following a dose of > 10 000 r, malformation (elytrae) was observed in some adults.

790 Laviolette, P., Nardon, P. INFLUENCE DE L'IRRADIATION SUR LES ADULTES DE SITOPHILUS SASAKII TAKAHASHI (CURCULIONIDAE) ET LEURS DESCENDANTS. p. 431-40 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963".

Le rayonnement gamma de Co reduit sifnificativement la moyenne de vie. Tous les insectes meurent en 12 j à 8000 r, en 4 j à 100 000 r. La mort apparaît brusquement après une phase de latence plus ou moins longue selon la dose, variant de 12 j (5000 r) à 1 j (100 000 r). L'étude du coefficient de variabilité et de la moyenne de survie en fonction de la dose suggère la présence de deux mécanismes sensibles détruits par l'irradiation. La stérilisation par les rayons X est plus efficace à 150 kV qu'à 80 kV. L'irradiation des parents a pour conséquence de diminuer la fertilité et le poids des descendants, et d'augmenter leur durée de développement. Ces effets se transmettent d'une génération à l'autre sans que l'expérimentateur procède à aucune sélection. Alors que les deux premiers tendent à disparaître, l'augmentation de la durée du développement reste stable pendant au moins 10 générations. (Voir 791).

791 Laviolette, P., Nardon, P. ACTION DES RAYONS γ DU COBALT 60 SUR LA MORTALITÉ ET LA FERTILITÉ DES ADULTES D'UN CHARANÇON DU RIZ. Bull. biol. 97 (1963) 305-33.

Le rayonnement γ issue de la bombe au ^{60}Co réduit significativement la moyenne de vie des males de Sitophilus sasakii à partir de 5000 r, et celle des femelles à partir de 7000 r. A 8000 r, tous les Insectes meurent en 12 j. Jusqu'à 6000 r, l'étude de la répartition de la mortalité dans le temps montre que l'irradiation fait apparaître progressivement une hétérogénéité dans la populations, isolant des individus plus résistants. L'examen des courbes de survie révèle que la mort est toujours différée. Elle se déclenche brusquement après une période de latence plus ou moins longue selon la dose. L'étude de la variabilité montre que selon la dose, l'irradiation augmente ou diminue la sensibilité des Insectes aux variations incontrolables du milieu. La sensibilité au rayonnement semble augmenter avec l'age. Dès 2000 r la fertilité se trouve réduite de moitié. A 5000 et 6000 r on observe une phase de stérilité temporaire. La stérilisation totale est acquise à 15 000 r. La fécondité est beaucoup moins résistante que la fertilité, puisque même à 16 000 r des œufs sont pondus. Il est possible d'envisager l'emploi des radiations pour la désinsectisation des denrées. (Aut.)

792 Lee, W.R. RELATION OF DOMINANT LETHALS TO DOSE IN THE HONEY BEE. (Abstr.) Genetics 48, 7 (1963) 897.

Variation in egg viability among individuals has made precise determinations of dominant lethal mutation rates difficult at rates less than 0.1. To overcome this difficulty a technique of partial-body irradiation was developed which made it possible to make all comparisons intra-queen. Six queens were paired into three groups, and frames of eggs from the two queens in a group were always paired and tested together for egg viability in the same colony. The viability ratio was taken as the ratio of the proportion of eggs hatching from queen "A" of each pair divided by the proportion of eggs hatching from queen "B" so as to correct for environmental variation. After these tests the spermathecae of "A" were irradiated with 260 r of 50 KVP x-ray and the viability tests repeated. 2000 gametes of each queen were tested in each test. The post-irradiation tests were conducted after the irradiated queen had laid eggs for one week; hence the eggs tested for viability had at the time of irradiation been oögonia in a well-shielded anterior region of the ovary. This procedure was repeated twice in order to give accumulated doses. After correcting each pair to make the pre-irradiation ratio unity, and then averaging the three pairs, the following proportions of dominant lethals (corrected for saturation effect) were found: 260 r, 0.08; 520 r, 0.26; and 780 r, 0.38. The dosage response curve varied as the 1.4 power of the dose, being significantly non-linear.

793 Lefevre, G., Jr., Jonsson, U.B. SPERM TRANSFER, STORAGE, DISPLACEMENT, AND UTILIZATION IN Drosophila melanogaster. Genetics 47, 12 (1962) 1719-36.

p.1727-8 describe an experiment on sperm displacement carried out with (5000 r x-irradiated) males. It showed that such sperm were not as effective in displacing sperm from the female storage organs as sperm from normal (wild type) males. It may well be that irradiation not only produced a high level of dominant lethality but some inactivation of the sperm as well.

794 Lindsley, D.L. A MUTUAL SPARING EFFECT OF THE X AND Y CHROMOSOMES TO THE STERILIZING EFFECTS OF X-RAYS. (Abstr. B1A956) p.57-8 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

It appears that when both the X and the Y chromosomes are present in the same irradiated sperm they have some sparing action on each other. Three types of male sterility are observed in the sons of irradiated males: prespermatogenic, spermatogenic, and postspermatogenic. In the present experiments > 600 males were dissected and scored microscopically for the type of sterility.

Spermatogenic sterility was the only class that showed an increase with dose and was by far the most frequent. It is characterized by a fairly normal testis distally with, however, a large region of necrotic tissue in the proximal part, and by empty seminal vesicles.

795 McDonald, D.J., Long, H.C. EFFECT OF NEUTRON IRRADIATION ON THE FERTILITY OF Tribolium confusum. Amer. Nat. 95 (1961) 124-6.

Preliminary experiments were carried out on adult males of T. confusum, which were exposed to a neutron dose of about 500×10^8 n/cm² or about 254 rads. Although subsequent matings indicated a significant difference in fertility between the irradiated and control males ($F = 36.2$, $n_1 = 1$, $n_2 = 47$) there seems to be no significant change in fertility during those post-irradiation observation periods (6) for which matings and offspring were tested, i.e. there is no indication of a differential sensitivity of the male germ cells in T. confusum. These studies are being followed up.

796 McDonald, D.J. THE EFFECT OF NEUTRONS AND X-RAYS ON THE FERTILITY OF Tribolium confusum (Abstr.) Genetics 46, 8 (1961) 881.

The effect of 180 kV x-rays and fast neutrons with an average energy of about 4 MeV, on the fertility of males of the flour beetle T. confusum was investigated by mating each irradiated male with 10 successive females for 2-d periods and determining, in the x-ray experiments, the percent of viable eggs and in the neutron experiments, the number of offspring produced by the females over several days 29.6% of the eggs produced by 120 females mated with 10 males receiving 2900 r of x-rays, developed into adults, compared to 39.9% for 10 males receiving 1450 r and 82.2% for ten unirradiated control males. Viability of eggs produced by females mated with x-rayed males 11 to 12 d after irradiation reached minimal values of 10.5% and 30.2% in the higher and lower dose experiments respectively, probably reflecting differences in the sensitivities of cells in various stages of spermatogenesis. Hatchability in the 2900 r experiments tested 55 d following irradiation of the males, had attained control levels, indicating the absence of any permanent damage. – In the preliminary experiment with neutrons the mean number of off-spring produced by the females mated with irradiated males was 59.3 compared to 77.0 for the controls. No significant difference in the fertility of the males during the 12 d following irradiation was noted.

797 McDonald, D.J. X-IRRADIATION OF THE DEVELOPING MALE GERM CELLS OF Tribolium confusum. Genetics 46 (1961) 1511-7.

Young adult males of the flour beetle, T. confusum, have been shown to require about 4 d, following eclosion, to reach sexual maturity. Subjecting 2- or 3-d-old males to 1450 or 2900 r of x-rays depresses their fertility, as evidenced by the increase in the percentage of inviable eggs produced by their mates. This inviability, probably due in part to the induction of dominant lethals, reaches a maximum value 11 to 12 d following irradiation, and then declines. In general, the pattern of response suggests the various stages of spermatogenesis of T. confusum are differentially sensitive to x-rays. No evidence was found for recovery of irradiated sperm stored by females, or of extended effects on the fertility of the treated males. (Auth.)

798 Michigan State Univ., East Lansing, Mich. BASIC FERTILIZATION PHENOMENA AND GAMETIC LETHALITY IN Drosophila. Technical Progress Report. TID-15021. 1962. 4p.

The processes involved in normal insemination in D. melanogaster are being studied by dissection and observation of the genital tract of inseminated females at intervals following copulation. Movement of the spermatozoa into the ventral receptacle of the female did not seem to be accomplished by swimming action of the sperm, but groups of longitudinally-oriented sperm appeared to be drawn en masse into the ventral receptacle. Definite mating preferences of males and females correlated with strain were noted. Observations of females irradiated after insemination supported the hypothesis that irradiation produces a lethal, rather than merely deleterious, effect on the mature sperm cells. Differential survival of gametes was examined by two genetic techniques. Data from both of the experiments agreed in suggesting an apparent enhancement of radiation damage in stored sperm. (NSA 16:1962, 9845)

799 Mortimer, R.K., Borstel, R.C. von. RADIATION-INDUCED DOMINANT LETHALITY IN HAPLOID AND DIPLOID SPERM OF THE WASP Mormoniella. Genetics 48, 11 (1963) 1545-9.

A doubling of the chromosome complement on Mormoniella sperm from haploid to diploid doubles the sensitivity to radiation when dominant lethality is the criterion. X-rays were used.

800 Oftedal, P. INDUCTION OF MUTATIONS AND CELL KILLING IN IRRADIATED Drosophila SPERMATOGONIA. (Abstr. 5.43) p.69-70 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Treatments of Drosophila spermatogonia with acute doses of 55 r, 110 r, 160 r and 310 r gave a clearly non-linear dose-effect curve for sex-linked recessive lethals. In order to explain the results, a mathematical model for the irradiated cell population has been formulated, considering cell killing, variation in sensitivity to killing and to mutation induction with cell cycle stage, and lenght of cell cycle. Thus, the frequency of mutations observed will be equal to the product of: dose absorbed by sensitive cells × number of sensitive cells × sensitivity of sensitive cells × survival of sensitive cells, divided by: total number of cells in population less killed sensitive cells. In this first approximation, effects on resistant cells have been disregarded. According to this model, protraction of doses in this dose range should lead to higher yields of mutants. Protraction of 144 r, 267 r, and 542 r over 8 h (4 spermatogonial cell cycles in the irradiated embryo), have given results in support of the hypothetical model, showing a linear increase in mutation rate with dose, with a slope higher than 2×10^{-5} sex-linked lethals per r, indicating a sensitivity at least as high as for mature sperm, for doses lower than a few hundred r.

801 Oftedal, P. GENETIC SENSITIVITY AND DIFFERENTIAL KILLING IN IRRADIATED Drosophila SPERMATOGONIA. (Abstr.) Int. J. Rad. Biol. 6, 5 (1963) 490.

Irradiation of Drosophila spermatogonia in 20 ± 3-h-old eggs/larvae with doses of 0 r, 56 r, 109 r, 163 r and 307 r, at 25 r/min, have resulted in sex-linked recessive-lethal frequencies indicating a non-linear dose-effect relationship with reduced effects at the higher doses. It was hypothesized that the spermatogonia constitute a cell-population heterogeneous as regards sensitivity both to mutation-induction and to cell-killing. In a population of N spermatogonia, a dose D would then lead to the observable genetic effect

$$E_{obs} = \frac{D \sum_{k=1}^{N} n_N s_N (1 - k_N)}{\sum_{k=1}^{N} n_N (1 - k_N)}.$$

If the sensitivity to mutation-induction s_N is correlated with the survival function $(1 - k_N)$, this expression leads to non-linear dose-effect curves. These can be fitted to the experimental results if assumptions are made about the relative frequency of sensitive cells in the population, and about the shape of the survival-curve. This formulation of the hypothesis also leads to the prediction that protraction of the doses over several cell-cycles should lead to higher yields of mutations, since sub-killing damage should be repaired for each cell-generation, in accordance with Elkind's observations. This prediction has been tested by giving similar doses over 8 h, which cover 3-4 cell-cycles. The results show a significantly higher effect at the 300 r level and a reasonable quantitative agreement with the predictions.

802 Oftedal, P. INDUCTION OF MUTATIONS AND KILLING OF CELLS IN IRRADIATED SPERMATOGONIA OF Drosophila. Nature, Lond. 199 (1963) 1301-2.

If a given dose were protracted over several cell generations, the observable genetic damage should be higher than that found after acute treatments. This hypothesis was tested with doses of 144 r and 267 r, as against 8-h-irradiations of spermatogonia at 25 r/min. The results seem to support the idea of differential killing as an explanation. The effect is similar to that found by Tazima et al. (1143) after irradiation of silkworm larvae, 3-10 d old, and opposite that found after treatment of earlier stages. The results are not in agreement with those reported by numerous other workers.

803 Parfenov, G.P. APPEARANCE OF DOMINANT LETHAL MUTATIONS IN Drosophila melanogaster DURING COSMIC FLIGHT ON SHIP-SATELLITE. p.324-9 in FTD-MT-62-78, n.d. Translation.

A significant increase in frequencies of dominant lethal mutations in spermatides of male D. melanogaster occurred during a satellite flight. Data indicate that the increase was the result of rocket vibrations rather than radiation dose. (From NSA 17 : 1963, 35280).

804 Pelerents, C. QUELQUES RESULTATS SUPPLEMENTAIRES CONCERNANT L'INFLUENCE DES RAYONS GAMMA SUR LES CHRYSALIDES ET LES ŒUFS DE LA TEIGNE DE LA FARINE "EPHESTIA KUEHNIELLA Z." Rev. Agric. 16, 2(1963) 305-20.

En irradiant des chrysalides adultes (15 j) avec 600 00 rad, il est possible d'obtenir des males stériles et agressifs. Par contre, à l'âge de 3 j les rayon γ occasionnent un ratatinement des ailes, le pourcentage d'éclosion et la durée de vie sont fortement réduits et la tendance à l'accouplement a comlètement disparu. L'influence des rayons γ (500-2500 rad) sur embryons est fonction de l'âge de embryons. Les individus ne réagissent pas de la même façon à une dose identique. Les influences sur la fertilité sont héréditaire, la fertilité étant très probablement tributaire de plusieurs gènes. Les spermatogonies sont plus sensibles aux mutations que les oögones. Les moyennes d'éclosion des papillons F_1 sont plus élevées dans les croisements entre teignes normales et irradiées qu'en endogamie. L'on trouve chez les femelles irradiées au stade embryonaire 2 sortes de stérilité: l'effet d'une dose de 7000 rad est plus prononcé chez les embryons de 4 j (pas d'œufs) que sur les embryons de 6 j (présence d'œufs mais absence d'éclosion). Au point de vue pratique, il est plus facile de rassembler et de traiter des œufs que des chrysalides. Les essais ont prouvé la possibilité d'induire chez les chrysalides et chez les embryons des mutations (du type dominant dans le cas de la teigne) qui provoquent un certain degré de sterilité.

805 Pendlebury, J.B., Jefferies, D.J., Banham, E.J., Bull, J.O. SOME EFFECTS OF GAMMA RADIATION ON THE LESSER GRAIN BORER (Rhizopertha dominica F.), TROPICAL WAREHOUSE MOTH (Cadra (Ephestia) cautella Wlk.), INDIAN MEAL MOTH (Plodia interpunctella Hübn.), AND THE CIGARETTE BEETLE (Lasioderma serricorne F.). AERE-R-4003, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1962. 23p.

Various effects of γ-radiation on 4 stored products pests, which infest grain and cereal products in varying degrees, were examined with particular emphasis on susceptibility to radiation sterilization. R. DOMINICA, described as the most destructive pest of grain, and L. serricorne, occasionally found infesting cereal products, are effectively sterilized by the dose (16 000 rads) evaluated for the control of large populations of grain weevil. C. cautella and P. interpunctella, principally pests of dried fruits, but occasionally imported on infested cereals, are more resistant to radiation sterilization. 16 000 rads is unlikely to be completely effective for their control. (Auth.)

806 Pesson, P., Vernier, J.M. LA PROTECTION DES DENRÉES CONTRE LES INSECTES RAVAGEURS PAR L'EMPLOI DES RADIATIONS IONISANTES EN VUE D'OBTENIR LA STÉRILITÉ DES INSECTES ADULTES. ÉTUDE PARTICULIÈRE DE LA RÉACTION DES GONADES DE "Sitophilus granarius". Ann. Nutr., Paris, 17, 6 (1963) B-487-B497.

Divers stades de développement de certains coléoptères infestant des céréales, en particulier, S. granarius, ont été étudiés par l'emploi des radiations γ(^{60}Co, 1000-20 000 rads). La radiosensibilité se montre supérieure chez les mâles où les létales et les doses stérilisantes sont voisines. Les auteurs considèrent quelques modifications histologiques et cytologiques de l'appareil sexuel dues aux radiations ionisantes.

807 Proverbs, M.D., Newton, J.R. SOME EFFECTS OF GAMMA RADIATION ON THE REPRODUCTIVE POTENTIAL OF THE CODLING MOTH, Carpocapsa pomonella (L.) (LEPIDOPTERA: OLETHREUTIDAE). Canad. Ent. 94, 11 (1962) 1162-70.

The reproductive potential of the codling moth, Carpocapsa pomonella, was reduced about 75% when 50 γ-irradiated male moths (exposed as mature pupae to 30 000 and 40 000 rads) were caged in the laboratory with 5 normal male and 5 normal female moths. The reduction in reproductive potential was less marked when both 50 irradiated (30 000 rads) males and 50 irradiated (30 000 rads) females were added to the normal insects. Eighty-nine to 99% of the mature larval offspring of irradiated (30 000 rads) male x normal female moths were males; the male offspring were largely sterile and the female offspring completely so. Sperm from irradiated (40 000 rads) male moths were less competitive than those from normal males. (Auth. summary).

808 Proverbs, M.D., Newton, J.R. SUPPRESSION OF THE REPRODUCTIVE POTENTIAL OF THE CODLING MOTH BY GAMMA IRRADIATED MALES IN CAGED ORCHARD TREES. J. econ. Ent. 55, 6 (1962) 934-6.

Fully developed pupae of the codling moth, Carpocapsa pomonella (L.), were exposed to 40 000 rads of γ-radiation and the emerged adults caged with normal moths over dwarf apple trees. The average numbers of mature larval offspring per cage that developed when each cage was supplied with (a) 5 normal male, 5 normal female, and 50 irradiated male moths, (b) 5 normal male, 5 normal female, 50 irradiated male, and 50 irradiated female moths, or (c) 5 normal male, 5 normal female, and no irradiated moths were: 6.0 in (a), 16.6 in (b), and 40.3 in (c). In another experiment, in which the number of normal moths remained the same but the number of irradiated moths of each sex was increased from 50 to 100, the average numbers of mature larvae that developed in each cage were 0.7, 2.0, and 33.3, respectively. (Auth.)

809 Proverbs, M.D. STERILIZATION OF THE CODLING MOTH BY GAMMA-IRRADIATION. Nature, Lond. 194, 4835 (1962) 1297.

When male pupae, within 1 d of adult emergence, were exposed to 40 000 r of γ-rays (Co^{60}-source) dominant lethals were induced in about 99% (sperm) without affecting adult emergence, mating or adult longevity. Similar effects followed irradiation of 12-24 h old male moths. Further tests on radiosensitivity of different stages are reported. Experiments on matings amongst different sets and ratios of irradiated or control adults are described under laboratory and some under orchard (cage tests) conditions. Results indicate that the sterile male technique may be a promising method for the control of the codling moth, Carpocapsa (= Cydia) pomonella (L.)

810 Расулов, Ф.К. ВЛИЯНИЕ ГАММА-ЛУЧЕЙ НА СТЕРИЛЬНОСТЬ КАРАДРИНЫ. Хлопководство 7 (1963) 41-2.

Rasulov, F.K. ACTION DES RAYONS γ SUR LA STÉRILITÉ D'UNE NOCTUELLE DU COTON (GENRE Laphygma exigua). Khlopkovodstvo 7 (1963) 41-2.

The moth, Spodoptera exigua, is a cotton pest. Eggs, larvae and pupae were subjected to γ-radiation from a Co^{60}- source at 26 r/sec (total dose 3000-11 000 r), at 25°-27°C and a humidity of 65-75%. Irradiation with 3000 to 5000 r does not prevent larval development and does not inhibit larvae breeding. Exposure to 7000, 9000, 10 000 and 11 000 r permitted only a small number of larvae to reach maturity. Irradiation of male and female cocoons with 3000 r resulted in 36.8% sterility in males, at 5000 r-46%, 7000 r-45%, and 10 000 to 11 000 r-100%. Complete sterility was evident in females following exposure to 5000 r. Total sterilization of males and females was obtained with a dose of 9000-11 000 r. The life spans of mature moths from irradiated male cocoons was 4-5 d; for non-irradiated, 5-6 d.

811 Rhode, R.H., Egiosa, F., Lopez, D.F., Telich, D.J. EFFECT OF GAMMA RADIATION ON THE REPRODUCTIVE POTENTIAL OF THE MEXICAN FRUIT FLY. J. econ. Ent. 54, 1 (1961) 202-3.

Preliminary experiments are described on radiosensitivity of pupae. Adults of both sexes were rendered sterile when 12 d-old pupae were exposed to 5000 r. Longevity appeared normal, and neither aggressivity nor mating behaviour of young males was affected. Rate sensitivity was also investigated and results tabulated for 90 r, 70 r, 50 r, 30 r and 10 r/min. In tests with caged fly populations the almost total eradication at the 50: 1 overflooding rate was of unusual interest.

812 Sacca, G. ESPERIENZE CON MOSCHE DOMESTICHE, STERILIZZATE CON RAGGI X. (Study on houseflies, sterilized with x-rays). Atti Accad. naz. Ital. Ent., Rend. 8 (1961) 91-8. (In Italian, with English summary).

Experiments were conducted on radiosterilization of male houseflies. The females of Musca domestica are monogamous, so that all the females mating with sterile males lay sterile eggs. Tests with 24-kV x-rays showed that the most satisfactory method of sterilizing male houseflies consists of irradiating the pupa with 3000 r 2 to 3 d before emergence. The mortality of the irradiated pupae was not appreciably increased and the flies emerging from them were normal in appearance, viability, longevity, and sexual activity. When the irradiated males were mated with normal females, sterility was 100% complete. However, there was a slight tendency for females mated with irradiated males to remate with normal males. Sterile males successfully competed with normal males in search of females, and when they were present in overwhelming numbers succeeded in mating with most of the females, leaving them sterile. (From auth. summary). Also published in Rend. Ist. Super. Sanita 24 (1961) 5-12.

813 Takeda, H., Tanaka, K. STUDY OF THE INFLUENCE OF X-RAYS UPON THE HEMOCYTES OF THE SILKWORM LARVAE Bombyx mori, L. (Abstr.) p. 359 in "The 5th Japan Conference on Radioisotopes 21-23 May 1963". Tokyo, Japan Atomic Industrial Forum Inc.

An attempt was made to investigate damaging effects of x-rays (2000 r) on the number of blood cells of silkworm larvae on the 2nd day of the 5th instar. A marked decrease in haemocyte counts was observed. The extent of this drop is not connected with the sex of the larvae.

814 Tazima, Y., Onimaru, K. STUDIES ON THE GENETIC EFFECT OF RADIATION 1959-1960. II. STUDIES ON THE GENETIC EFFECT OF RADIATION WITH SILKWORM. (1) DIFFERENCES BETWEEN TIMES OF DEATH OF THE F$_1$ AFTER IRRADIATION OF OÖGONIA OR MATURE OÖCYTES. Nucl. Sci. Abstr., Japan 1, 3/4 (1962) 117-8. (In English).

Marked differences in radiation-induced mutation rates for different stages of gametogenesis have been observed in the silkworm, both for visible recessive mutations and dominant lethals. Maximum mutation incidence is observed in spermatids and mature oöcytes. In mature oöcytes the observed mutation rate is several times as high as in oögonia. By the specific locus methods with egg colour mutants it was found that induction rates rise linearly with increasing radiation doses applied to oögonia; with mature oöcytes, however, they increase rapidly with doses of power > 1. This suggests that most of the mutants induced in oögonia may be accompanied by gross chromosomal aberrations, aberration-bearing cells being eliminated subsequently in the long course of gametogenesis. Mortality was measured at various developmental stages of the F$_1$ from irradiated oögonia and irradiated mature oöcytes. 1000 r of Cs^{137} γ-rays were given. A considerable percentage of the F$_1$ individuals from irradiated mature oöcytes were found to be eliminated during the embryonic and larval stages, especially in the earlier stages.

815 Thomou, H. STERILIZATION OF Dacus oleae BY GAMMA RADIATION. p. 413-24 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Three developmental stages of the olive fly were exposed to γ-radiation from a Co^{60} source and the sterilization dose determined. For 4th-instar larvae the sterilizing dose was 2000 ± 300 rad, for pupae 11 000-15 000 rad and for adults 15 000-18 000 rad. Mating studies showed that sterility persisted throughout the life of the adults. The effect of dose on emergence was studied with 4th-instar larvae and pupae. The larvae were exposed to 300-3000 rad at 300-rad intervals, while the pupae were exposed to 3000-15 000 rad at 3000-rad increments. Maximum emergence was obtained when 8-d-old pupae were irradiated. Significant fluctuations occurred at all dose-rates. (From auth.)

816 Ulrich, H. X-RAY INDUCED "DOMINANT LETHALS" IN INSEMINATED EGGS OF Drosophila. (a) EXPERIMENTS IN THE STAGE BETWEEN COMPLETION OF MEIOSIS AND BEGINNING OF CLEAVAGE. (Abstr. 5.47) p. 71 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

In insects, pre-adult mortality of the progeny of irradiated parents is thought to result from radiation induced "dominant lethals" in the genome of the maternal or paternal gametes. These "dominant lethals" can be either gene or chromosome mutations. Similar radiation effects (e.g. embryonic mortality) are found if instead of the gametes the progeny (e.g. young embryos) is irradiated. This raises the question whether in both types of experiments pre-adult mortality is the result of "dominant lethals" (i.e. alterations in the genome) and/or "physiological effects" (i.e. effects in cell components other than chromosomes). During the last 10 years we have accumulated quite a number of experimental results on inseminated Drosophila eggs, x-rayed after deposition in the stage between completion of meiosis and beginning of first cleavage. Most data (e.g. differential radiosensitivity of cell parts with or without a nucleus, the one hit dose action curves for mortality and recessive lethals, influence of oxygen during irradiation, etc.) were consistent with the assumption that the most important radiation effects are alterations in the genome which behave like dominant lethals (probably of a one hit type predominantly). However, new results (experiments with cold post treatment and the analysis of radiosensitivity of eggs and embryos with different chromosomal constitutions) indicate that at least some of the radiation effects have to be considered as "physiological effects".

817 Walker, J.R. EVALUATION OF CONTROL OF EUROPEAN CORN BORER, Ostrinia nubilalis (Hübner), BY X-RAY INDUCED STERILITY. Diss. Abstr. 23 (1962) 761.

Records on emergence from 4 groups of untreated European corn borer larvae, involving 11 560 individuals, showed that on the 1st day of emergence 50% of the moths were females. After the 1st day of emergence, males outnumbered females with a gradual shift to more females during the latter part of the emergence period. The sex ratio of the moths studied was approximately 57% males and 43% females. Mating studies indicated that corn borer moths had a poor to moderate fecundity level. In cages containing eight males and eight females only 67.7% of the females mated. Also only 58-88% of the eggs deposited by females in the control matings hatched. Exposure of 1-d-old male moths to 32 000 r resulted in 1% egg hatch when they were mated to untreated females. The irradiated males competed equally with untreated males for virgin females. A ratio of 8 irradiated males to 4 untreated males to 8 untreated females resulted in 39.4% hatch of the deposited eggs. The survival of the irradiated males compared favourably with untreated males under laboratory conditions. Exposure of pupae to x-rays resulted in a reduction in the percent of egg hatch as the dose was increased. Female pupae were more susceptible to the effects of irradiation than male pupae. The percent of egg hatch varied with the age of the pupae at the time of treatment, younger pupae being more susceptible to irradiation than older pupae. (Auth.)

818 Walker, J.R., Brindley, T.A. EFFECT OF X-RAY EXPOSURE ON THE EUROPEAN CORN BORER. J. econ. Ent. 56, 4 (1963) 522-5.

When untreated virgin females were mated to male moths of the European corn borer [Ostrinia nubilalis (Hübner)] treated 1 d after emergence with 32 000 r of x-rays, only 1% of eggs hatched. Irradiated males competed equally with the untreated males for females. Moths caged together at a ratio of 8 irradiated males to 4 untreated males to 8 untreated females resulted in 39.4% hatch of eggs. Survival of the irradiated males compared favourably with that of untreated males under laboratory conditions. Exposure of pupae of both sexes to x-rays resulted in a reduction in % egg hatch as the dose was increased. Female pupae were more susceptible to irradiation than males. The % egg hatch varied with age of pupae at treatment, younger pupae being more susceptible to irradiation than older pupae. (Auth.)

819 Whiting, P.W. R-LOCUS FACTOR HOMOLOGIES IN Mormoniella. Genetics 47, 7 (1962) 921-36.

In the wasp Mormoniella, the complex locus, R, after irradiation-induced mutations, frequently contains deleterious factors, – lethals, male steriles, or female steriles. Only the last can be transmitted by haploid males and, therefore, homologies of lethals or of male steriles must be determined by use of diploid males, a mutant type aberrant for these insects. Normal diploid females heterozygous for one mutant lethal are crossed to diploid males heterozygous for another. Sperm of diploid males are diploid and hence triploid females are sired, one-half of which carry a lethal from each parent, one-half, the paternal lethal only. By use of proper eye colour tags, diploid F$_2$ males carrying two different lethals can be identified. Any theoretically expected type of eye colour in diploid males not found, indicates homology of the lethals, such males being inviable. Among 53 tests of 31 genes bearing lethals (or male steriles) only one combination proved inviable. The fact that most deleterious changes caused by mutation are non-homologous, affecting different vital processes, indicates great complexity of this single locus, R. "Self-tests" were made by the same method as used for tests of lethals from separate mutations. As expected, the diploid males homozygous for the same lethal were in no case viable. Comparisons are discussed between the R locus of Mormoniella and the "super-genes" of polymorphic species as also the induced complex genes of Drosophila and microorganisms. (Auth.) BA : 41 : 1963, 8790.

820 Würgler, F.E. X-RAY INDUCED "DOMINANT LETHALS" IN INSEMINATED EGGS OF Drosophila. (b) EXPERIMENTS WITH DIFFERENT STAGES BETWEEN INSEMINATION AND END OF SECOND CLEAVAGE DIVISION. (Abstr. 5.48). p. 71-2 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.1". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

The nature of x-ray induced mortality in inseminated Drosophila eggs has been studied by analysing the radiosensitivity in different stages of meiosis and early cleavage. The highest sensitivity was found during late anaphase/early telophase of meiosis II and each cleavage division analysed so far. Sensitivity was lowest when the nuclei were in interphase. Dose action curves for the different stages vary greatly in shape and slope. The one hit curve found for egg samples containing all stages between completion of meiosis and beginning of cleavage (see 816) could be shown to result from superposition of different non linear dose effect curves. This result invalidates the strongest argument supporting the hypothesis that radiation induced mortality is of a one hit type. It has been shown by various authors that insect embryos developing from irradiated gametes can die at different stages of development. In Habrobracon and Drosophila different lethal syndromes seem to result from different kinds of nuclear damage as shown by Von Borstel (1961). Different lethal syndromes can also be distinguished after irradiation of inseminated Drosophila eggs. The dependence of the relative frequencies of different syndromes after irradiation in specific stages of nuclear divisions and the dose dependence of the different syndromes have been recorded. The results indicate that radiation induced genetic effects alone can hardly explain all the facts.

821 Virkki, N. GAMETOGENESIS IN THE SUGARCANE BORER MOTH Diatraea saccharalis (F.) (CRAMBIDAE). J. Agric. Univ. P.R. 47, 2 (1963) 102-37. (In English, with Spanish summary).

The gametogenesis of the moth was studied cytologically, in order to gain general information on the plausibility and means of obtaining sterile males by irradiation. The following stages require to be irradiated: - to affect spermatogonia and early spermatocytes: 7-10 d old larvae; to affect all stages of spermatogenesis; larvae > 15 d old; to affect spermiohistogenesis: pupae.

See also:

854 The action of radiation and other mutagenic agents (1) in inducing mutation in Drosophila females, and (2) in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, 1961)
855 The action of radiation and other mutagenic agents (1) in inducing mutation in Drosophila females, and (2) in controlling the action of specific genes responsible for suppressing uncontrolled growth. Report Covering 9-Year Period, May 1, 1953-April 30, 1962.
878 Mutations in the screw-worm fly. (LaChance and Hopkins, 1962)
465 Inhibited oviposition by females of Gryllus assimilis (F.) induced by radioactive males, using L-methionine-methyl-^{14}C. (Abdel-Malek, 1961)
467 Inhibitory effect of L-methionine-methyl-^{14}C on oviposition by females of the cotton leaf worm, Prodenia litura (F.), induced by radioactive males. (Abdel-Malek, 1963)
470 Effects of ingested Pu^{239} on fecundity, fertility and life span of Habrobracon (Hymenoptera: braconidae). (Erdman, 1962)
472 The genetic and developmental effects of ingested radioactives in Habrobracon. (Grosch, 1960)
476 Certain biological effects produced in the boll weevil by tagging it with P^{32}. (Mayer and Brazzel, 1961)
881 Radiation induced viability mutations in the honey bee. (Lee, 1963)
912 X-ray induced visible mutations in Habrobracon oöcytes. (Whiting, 1963)
981 X-autosomal translocations of Drosophila melanogaster. (Warters, 1963)
991 Contrasts in radiation-induced mutation rates at different meiotic stages. (Whiting, 1962)
1000 Mutagenic sensitivity of sperm, spermatids, spermatocytes, and spermatogonia in Drosophila melanogaster. (Chandley and Bateman, 1961)
1002 Effects of x-ray irradiation in Drosophila virilis at different stages of spermatogenesis. (Clayton, 1962)
1016 Spermatogenesis of the silkworm and its bearing on the radiation induced sterility. (Sado, 1961)

1024 Considerations on the changes in observed mutation rates in the silkworm after irradiation of various stages of gametogenesis. (Tazima, 1961)
1028 Synaptic modification of dominant lethal frequencies after irradiation of the Drosophila testis. (Thompson, 1962)
1036 The relationship of radiations and environmental changes in oxygen concentration for biological damage in the immature germ cells of Drosophila virilis. (Alexander, 1958)
1037 The effects of radiation on the genetic system of organisms in relation to their physiological and biochemical systems. Progress Report, May 1, 1957-April 30, 1958. (Alexander, 1958)
1038 Biological damage in the mature sperm of Drosophila virilis in oxygen and nitrogen with different dose intensities of gamma rays. (Alexander and Bergendahl, 1962)
1040 The response of pre-meiotic and post-meiotic germ cells of Drosophila to dose fractionation and changes in partial pressures of gases. (Alexander, 1962)
1045 Influence of aeration during gamma irradiation of screw-worm pupae. (Baumhover, 1963)
1048 Alteration of mutation frequency by treatment with actinomycin D. (Burdette, 1961)
1049 The effects of nitric oxide on radiation damage in Drosophila virilis and Drosophila melanogaster. (Capps, 1961)
1053 Further observations on the relation between gas pressure and the x-ray damage in Drosophila melanogaster. (Chang, 1962)
1068 Studies on the genetic effect of radiation with silkworm. (Japan. National Inst. of Genetics, Mishima. 1963).
1075 Enhancement of radiation-induced sterility in insects by pretreatment in CO$_2$ + air. (LaChance, 1963)
1080 The effect of culture environment on the susceptibility of the grain weevil Sitophilus granarius L. to gamma radiation. (Martin, et al., (1962)
1082 Tolerance of gonial cells of Drosophila melanogaster for heavy X-ray doses divided into installments. (Meyer, et al., 1959)
1092 Effects of variable dose-rates on radiation damage in the rust-red flour beetle, Tribolium castaneum Herbst. (Nair and Subramanyam, 1963)
1103 The influence of temperature upon the radiation susceptibility of Sitophilus granarius L. (Pendlebury et al., 1962)
1104 Pathogenic effect of low and medium doses of gamma-rays on the progeny of irradiated insects. (Podolyan, 1963)
1116 Some effects of nitric oxide and oxygen on dominant lethal production in x-irradiated Drosophila virilis males. (Rinehart, 1962)
1117 Some effects of nitric oxide and oxygen on dominant lethal production in x-irradiated Drosophila virilis males. (Rinehart, 1963)
1123 The effect of carbon monoxide as a respiratory inhibitor on the production of dominant lethal mutations by x-rays in Drosophila. (Schmid, 1961)
1137 Effect of 2,4-dinitrophenol on irradiation-induced dominant lethals factors in Drosophila melanogaster. (Steger, 1962)
1144 Dose-rate dependence of radiation-induced mutation rates and selective killing. (Tazima and Kondo, 1961)
1145 Further studies on two types of dose-rate dependence of radiation-induced mutation rates in spermatogonia and oögonia of the silkworm. (Tazima and Kondo, 1962)
1159 The effect of temperature during irradiation on the brood-pattern of dominant lethals induced in Drosophila melanogaster sperm. (Wedvik and Strømnaes, 1963)
1169 The effects of gamma radiation and apholate on the reproductive tissues of Drosophila melanogaster Meigen. (Cantwell and Henneberry, 1963)
1173 Cytogenetic investigations on the nature of dominant lethals induced in meiotic oöcytes by gamma radiation and alkylating agents. (LaChance and Riemann, 1963)
1175 Mutational response of Habrobracon oöcytes in metaphase and prophase to ethyl methanesulfonate and nitrogen mustard. (Löbbecke and Borstel, 1962)
1180 Preliminary observations on chemosterilization of mosquitoes. (Weidhaas et al., 1961)
1196 The effect of x-radiation on the spermatogenesis of Petrobius maritimus. (Mathur, 1961)
1213 A comparative assessment of the injurious effect of ionizing radiation on heredity in mouse and Drosophila. (Shapiro et al., 1963)
1214 Preliminary studies on the effect of x-ray on Tribolium imagoes. (Sokoloff, 1961)
1215 Irradiation experiments with Tribolium. (Sokoloff, 1961)
1222 Effects of radiations on insects. (La Chance, 1962)
1227 Effects of gamma radiation on various stages of three fruit fly species. (Balock et al., 1963)

1228 The susceptibility of the confused flour beetle (Tribolium confusum Duv.) to gamma radiation. (Banham, 1962)
1237 Control of the Mediterranean flour moth Anagasta kühniella Zell by sterile male release. II. Susceptibility to gamma radiation. (Bull and Wond, 1963)
1247 Comparative x-ray sensitivity of Tribolium confusum and T. castaneum (Coleoptera: Tenebrionidae) at different developmental stages during their lifecycle. (Erdman, 1962)
1256 Effects of 300 kV x-ray radiation on Sitophilus oryzae. (Hoover et al., 1963)
1263 Radiosensitivity of the various stages of oögenesis in Callitroga hominivorax. (LaChance, 1961)
1264 Radiosensitivity of developing reproductive cells in female Cochliomyia hominivorax. (LaChance and Leverich, 1962).
1276 Studies on the biological influence of the termites exposed to Co^{60} gamma source. I. Influences on the adult of Formosan termite and its offspring. (Nakajima et al., 1963)
1281 Invloed van Gammastralen op eitjes van Ephestia kuehniella Zell. (The effect of γ-rays on eggs of Ephestia kuehniella Zell). (Pelerents and Brande, 1961)
1284 Influence of gamma radiation on the development and fertility of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962)
1285 Radiosensitivity of various stages of Callosobruchus chinensis L. (Quraishi and Metin, 1963)
1287 Fecundity studies on x-rayed Mormoniella vitripennis. (Ray, 1963)
1290 Investigations on the spermatogenesis and embryonic development following irradiation of Calliphora erythrocephala Meig., Diptera, Calliph. males.) (Taege, 1963)
1297 Effects of desiccation of Drosophila females on the frequencies of irradiation induced embryonic abnormalities. (Annan and Reitan, 1961).
1310 Changes in quantitative traits under selection and irradiation. (Bartlett, 1963)
1322 Effect of ionizing radiation on Sitona weevils. (Alimdzhanov and Khakimova, 1962)
1327 The effect of gamma radiation on the viability and fertility of Lucilia sericata Mg (Dipt.) irradiated as pupae. (Donnelly, 1960)
1330 The influence of X-rays on longevity, fecundity and fertility of Drosophila melanogaster. (Nöthel, 1963)
1351 The influence of x-rays on the vitality of Drosophila melanogaster. Studies of mortality, fecundity, and fertility after various doses. (Nöthel, 1963)
1354 Some early effects of ionizing radiation on the German cockroach, Blattella germanica. (Ross and Cochran, 1963)
1363 The effects of continuous and fractionated doses of gamma-radiation on the survival and fertility of Sitophilus granarius (Calandra granaria L.). (Jefferies, 1962)
1364 The effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (Calandra granaria) L. (Jefferies and Banham, 1961)
1371 Resistance of Sitophilus granarius and Sitophilus oryza at different stages of their development to γ-irradiation from cobalt-60. (Bruel and Bollaerts, 1960)
1372 X-ray effects on single and mixed species populations of Tribolium confusum and Tribolium castaneum (Coleoptera: Tenebrionida. (Erdman, 1962)
1373 The differential sensitivity of flour beetles, Tribolium confusum and T. castaneum to x-ray alteration of reproductive abilities, induced dominant lethals, biomass, and survival. (Erdman, 1963)
1375 The importance of competitiveness of radiosterilized males in mosquito-control programmes. (Dame and Schmidt, 1962)
1382 The effects of gamma radiation on the biology and behaviour of forest insects and the possibility of their control by means of irradiation techniques. (Stark, 1963)
1383 Some components of adaptive values of heterozygous Drosophila willistoni from irradiated natural populations. (Marques and Maciel, 1961)
1409 Further data on overdominance. (Wallace, 1963)
1410 Further data on the overdominance of induced mutations. (Wallace, 1963)
1414 Effects of radiation on ecological systems. (Erdman, 1963)
1427 Effects of ionizing radiation on insects and other arthropods. (Stone, 1963)
1436 Research on radiation in insect control. (Weidhaas et al., 1962)
1443 Cobalt-60 sterilization studies with Aedes aegypti (L.) (McCray et al., 1961)
1447 Laboratory studies on the use of irradiated sterile males to reduce C. fatigans Wied. populations. (Ramakrishnan et al., 1962)
1450 An experiment in the field with irradiated male Musca domestica in a rural zone in the Province of Latium. (Rivosecchi, 1962)
1453 The application of nuclear energy to agriculture. A Supplementary Report. (Moh, 1962)
1454 The application of nuclear energy to agriculture in Latin America. (Moh, 1963)

1455 Sterilization of the Mediterranean fruit fly and its application to fly eradication. (Katiyar and Valerio, 1963)
1456 The application of nuclear energy to agriculture. (Moh, 1963)
1460 Investigations on the sterilization of pernicious insects with ionizing radiations. (Baccetti and Cappellini, 1961)
1462 Possible use of ionizing radiations against the pine moth. (Baccetti and Zocchi, 1962)
1464 Could this be death to the codling moth? (Proverbs and Newton, 1961)
1465 Effect of gamma rays on insects. Progress on the use of induced sexual sterility for the control of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs, 1961)
1466 Control of the codling moth, Carpocapsa pomonella (L.) by the release of sexually sterile males. (Proverbs, 1963)
1468 Quelques effets des rayons gamma sur la teigne de la farine et sur divers nématodes. (Brande and Pelerents, 1962)
1469 Control of the Mediterranean flour moth Anagasta kühniella Zell. by sterile male release. I. Biological studies related to large scale rearing. (Bull and Wond, 1962)
1473 Irradiation. A sterilization weapon against the corn borer. (Springell, 1963)
1476 On the role of lethal mutants in the control of populations. (Borstel and Buzzati-Traverso, 1962)
1479 Control of weevil populations Sitophilus granarius L. with sterilising and substerilising doses of gamma radiation. (Cornwell et al., 1962)
1482 The control of warehouse pests by gamma radiation. (Rasulov and Anastasjev, 1963)
1486 Effects of gamma radiation on some wood-boring insects. (Bletchly, 1961)
1493 Irradiation of fruits and vegetables in a mobile cobalt 60 unit. (Harvey, 1963)
1497 Les possibilités d'emploi des radiations dans la lutte contres les insectes. (Nardon, 1963)
1499 Utilisation des radiations ionisantes (^{60}Co) pour la protection des denrées contre les insectes nuisibles. Recherches relatives à la détermination des doses utiles pour assurer la stérilité des insectes. (Pesson, 1963)
1580 Travaux de recherches utilisant les isotopes et les rayonnements nucléaires en entomologie appliquée en France et dans les pays associés. (Pesson, 1962)

I-A-3 RECESSIVE MUTATIONS. VISIBLE MUTATIONS. SUBVITAL AND SEX RATIO EFFECTS

822 Abrahamson, S. POSSIBLE REPAIR OF X-RAY INDUCED MUTATION IN Drosophila melanogaster*. (Abstr.) Genetics 46, 8 (1961) 845.

Dr. Newton Morton's observation that irradiated sperm produced a shift in sex ratio significantly larger than expected has resulted in our doing several large-scale experiments to determine underlying mechanisms. Males (v dy g) receiving 2700 r and corresponding controls were mated either to sc^{S1} B InS w^{a} sc^{8} (Basc=M-5) females or to y f reversed acrocentric females needing the Y chromosome for survival. Mating (1) yields the sex-linked recessive lethal rate; the second gives the induced sex ratio shift, found to be two or more times greater than expected from the lethal frequency. Dominant lethality, detrimental but nonlethal mutations and mosaicism were considered as possible causes for the discrepancy. – In the sex ratio scheme, loss of X or Y chromosome results in zygotic death; possible unequal sex chromosome dominant lethality should not be great enough to produce the observed shift. – Mating the F$_1$ patroclinous males to compound X females produced the control sex ratio rate, indicating that detrimental mutations were not the cause. – Mating about 1000 F$_2$ females from nonlethal Basc cultures produced an F$_3$ lethal rate corresponding to the control. Furthermore no lethals reverted. Threfore, lethal gonadal mosaicism was not operating to any appreciable extent. – If these factors play little role in producing the observed phenomenon, it seems likely that the sex ratio shift depends almost exclusively on sex-linked recessive lethality. – As a possible hypothesis, some induced mutations may be metastable. In the male zygote considerably fewer mutants might be repaired than in the female zygote. On this hypothesis the agent responsible for repair may be the unirradiated X. Alternatively somatic mosaicism without gonadal mosaicism resulting from early segregation in a two or more stranded chromosome structure remains a possibility.

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* (See also Rec. Genet. Soc. Amer. 30: 1961, 55.)

823 Abrahamson, S., Friedman, L.D. THE LINEAR RELATIONSHIP BETWEEN X-RAY DOSE AND LETHAL MUTATIONS RECOVERED FROM CELLS TREATED AS SPERMATOGONIA IN Drosophila. (Abstr.) p. 199 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Wild-type males of the Canton-S stock were irradiated with one of the following doses: 3000, 9000, or 12000 r. Each dose was delivered in two half-doses separated by a 24-h interval. For a 15-d period after irradiation, the males were supplied regularly with excess virgin females to exhaust the supply of germ cells which were post-gonial when treated. After 15 d, the males were singly mated with Basc/X-Y females. A single heterozygous Bar-eyed daughter from each P-1 male was subsequently tested for the presence of a sex-linked recessive lethal. The use of only one offspring from each irradiated parent eliminates the problem of dealing with clusters of cells descended from the same treated gonial cell. Our preliminary study demonstrated that 50% of the lethals obtained at 3000 r were recovered in such clusters. Confirmatory crosses were carried out on all lethals. Our criterion for lethality was the appearance of 10% or less of the wild-type class of males. The results to date are in remarkably good agreement with the rule of linearity of mutation rate to dose, as previously attained for spermatozoan cells. The data from two experiments are presented.

824 Alexander, M.L. THE ROLE OF RECOVERY MECHANISM AND OXYGEN EFFECTS UPON CHANGES IN RADIATION SENSITIVITY IN SPERM TREATED IN MATURE MALES AND FERTILIZED FEMALES OF Drosophila. Genetics 47 (1962) 1505-18.

An increase in biological damage in sperm treated in inseminated females was observed after treatment with either neutrons or x-rays. Recovery mechanisms cannot account for the high sensitivity with neutron treatment. The absence of recovery mechanisms was indicated by equal percentages of biological damage observed the first and second day after treatment with 2 MeV neutrons in air or with 14 MeV neutrons in nitrogen. The possibility of a post-radiation enhancement of radiation damage was observed when mature sperm were treated in inseminated females with x-rays in the presence of N_2 gas. The data indicate that an explanation for the increase in radiation sensitivity of mature sperm treated in fertilized females involves more than one factor, the relative importance depending upon the type of radiation and conditions at the time of irradiation. The neutron data show that the chromosomes change in some way to become more sensitive to radiation injury after fertilization. The x-ray data indicate that there may be differences in recovery occurring in genetic damage in sperm treated in males and inseminated females and that there is an increase in chromosome breakage which is associated with the increased sensitivity. There is also a correlation of an increase in chromosome breakage and the presence of oxygen and a possible post-radiation enhancement of radiation damage which may be associated with the presence or absence of O_2. (From auth.)

825 Abrahamson, S., Himoe, E. INDUCED MUTATION RATES IN SPERM TRANSMITTED TO SONS AND DAUGHTERS IN Drosophila melanogaster. Genetics 48, 8 (1963) 1085-7.

Irradiated* second chromosomes in wild-type D. melanogaster males were scored for induced lethal frequencies when transmitted to male and female progeny. No difference was observed between these two groups, and it has been concluded that the sex of the zygote which receives the irradiated chromosome does not influence the frequency of lethal mutations recovered. (Auth. summary.)

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* 3000 r x-rays.

826 Altenburg, E., Browning, L.S. THE RELATIVELY HIGH FREQUENCY OF WHOLE-BODY MUTATIONS COMPARED WITH FRACTIONALS INDUCED BY X-RAYS IN Drosophila SPERM. Genetics 46 2 (1961) 203-11.

Females were examined for the relative proportion of whole-body versus fractional mutations induced by x-rays (3000 r) in post-meiotic stages, in the X-chromosome of their male parent, at 14 visible loci. Parallel studies were made in a chemically treated and an untreated series. In the x-ray series, 93% of the mutations appeared to be whole-body, the remaining 7% being fractional. By contrast, in the chemically treated series and in the untreated (spontaneous) series, the percentage of fractionals was relatively high (30-67%). The implications of these results are discussed. In all 3 series the mutant tissue of the fractionals as a rule seemed to involve half of the body, as far as could be determined upon external examination of the fractions, and this is discussed.

827 Baldwin, W.F. THE EFFECT OF RADIATION DOSE RATE UPON THE PRODUCTION OF EYE COLOUR MUTATIONS IN THE CHALCID Dahlbominus. A/AC.82/G/L.717, Atomic Energy of Canada Ltd., Chalk River, Ont. 15 Dec. 1961. 12p.

All irradiations were confined to the larval stages of Dahlbominus fuliginosus (Nees) over the period from 5-9 d after propagation, i.e. after placing the females with host cocoons of the sawfly Neodiprion lecontei (Fitch). The genetic effects of acute (1000 r at 1000 r/min) and chronic (1000 r at 10 r/h) exposure from x-rays and Co^{60} respectively were investigated. The difference in mutation rates for eye-colour mutations with type of exposure proved to be small (~1.2) and not significant. Such factors as species differences, the masking effect of differential survival, the comparatively high dose rate (10 r/h) in chronic irradiation, or differences in the stages of development during irradiation may account for the small difference observed in Dahlbominus, as compared with those observed by other workers for Drosophila and Habrobracon.

828 Baldwin, W.F. THE EFFECT OF RADIATION DOSE RATE ON THE PRODUCTION OF EYE COLOR MUTATIONS IN THE CHALCID Dahlbominus. Rad. Res. 17, 2 (1962) 127-32.

See 827. The induced frequency exceeded the spontaneous frequency by approximately 35 fold. In these experiments, female germ cells were exposed in the oögonial stages of development. A preliminary description of the eye-colour mutations and of defective individuals found in offspring of irradiated mothers is included in the paper.

829 Baldwin, W.F. DOSE RATE EFFECTS ON THE YIELD OF RADIATION-INDUCED EYE COLOUR MUTATIONS IN AN INSECT. p.8 in "Radiation Biology in Canada 1962-63". CRB-1129, AECL-1701, Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 1963. 60p.

The investigation is carried out on the wasp Dahlbominus fuliginosis.

830 Baxter, R.C. RADIOBIOLOGIC STUDIES WITH Drosophila. (Abstr. B1F1005). p.73 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Genetic studies with D. melanogaster are centred upon the influence of dose rate and dose fractionation on recessive lethal mutation induction by ionizing radiation. Results so far agree with previously published findings by other workers with the mouse (Russell) and silkworm (Tazima and Kondo) that there is evidence for repair or recovery from genetic radiation damage.

831 Belitz, H.J. RECESSIVE LETHALS IN THE IV CHROMOSOME OF Drosophila melanogaster. (Abstr. 5.50) p.72 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

After x-ray treatment of ey^2/ey^2 males of D. melanogaster with doses of 3, 4.5 and 6 kr respectively 30 chromosomes with recessive lethals and 11 with semilethals were found. In allelic tests these 41 mutated chromosomes were outcrossed with each other. Two chromosomes contained two lethals each. Among the 43 mutations no more than 25 occupy one locus; the others are small deficiencies: 12 at least comprise 2 loci, 4 each 3 loci, and 2 four and 16 respectively. By aid of these overlapping deficiencies a part of this chromosome could be mapped over a range of about 20 loci including the locus of ci. Among the induced lethals two clusters were found; one consisted of 5 mutations induced in a spermatogonium and occupying probably one locus; the other was composed of two lethals, which gave a positive result in the allelic test, but proved to be overlapping small deficiences including the locus of ci.

832 Berendes, H.D. THE SALIVARY GLAND CHROMOSOMES OF Drosophila hydei STURTEVANT. Chromosoma 14 (1963) 195-206.

A cytological map of D. hydei, one of the species of the repleta group, is presented together with some cytological observations, including the description of 3 x-ray-induced rearrangements. A mutant Ar (Aristapedia) is a dominant autosomal character located on the 2nd chromosome, lethal in homozygous condition. The autosomal dominant mutant, L (Lobe), is characterized by almost complete female sterility; homozygotes are lethal. The Do (Dorens) stock contains males in which some of the sensilla campaniformia on the wing are converted into conspicuous bristles; females are seldom affected. The map of D. hydei is compared with the existing map of D. repleta Wollaston. In addition to the large standard rearrangements, a number of small differences are indicated. On the basis of rearrangements, two of the linkage groups are attributed to definite chromosomes.

833 Borstel, R.C. von. INHERITED PARTIAL STERILITY IN Habrobracon. (Abstr. 7.23) p.124-5 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

After x-irradiation, 27 cases of inherited partial sterility were found in Habrobracon. Of these, 12 of the females had hatchabilities between 30 and 40%. Six were below 30%, 4 were above 60%, and 5 were between 40 and 55%. By classic theory, it can be assumed that the 40-55% class involved adjacent I segregation and the 30-40% class involved mostly adjacent I and adjacent II segregation. The other classes require additional interpretations such as multiple chromosome involvements for those with hatchabilities lower than 30%, and translocations involving chromosome ends for those with hatchabilities above 60%. The time of death of the duplication-deficiency products is extremely regular among all of the induced cases, occurring at midembryonic stages of development. On the other hand, embryonic recessive lethal mutations are expressed at all stages of embryonic development from the blastula stage to hatching. Very few cases of inherited partial sterility are found in progeny from females irradiated in prophase I or metaphase I; inherited partial sterility is commonly induced after irradiation of males with mature sperm. (From abstr.)

834* Brown, S.W., Bennett, F.D. ON SEX DETERMINATION IN THE DIASPINE SCALE INSECT Pseudaulacaspis pentagonia (Targ.) (COCCOÏDEA). Genetics 46 (1957) 510-23.

The males are haploid (8 chromosomes) and the females diploid (16). Meiosis is normal in the female and replaced by a simple mitosis in the male. Egg production affords an example of combined sexual dimorphism and dichronism; the mothers first produce a series of eggs containing coral-coloured female embryos and then, without interruption, lay a series containing pinkish-white male embryos. Cytological study of early embryogeny shows that a chromosome set is eliminated to produce the haploid condition of the male embryos. Chromosomes broken by x-rays were used as genetic markers to demonstrate that the eliminated set is of paternal origin. Irradiation of fathers preferentially reduces the number of daughters. A similar effect on sex ratio following maternal irradiation cannot be explained on simple genetic assumptions and is believed to be attributable to a physiological effect of x-rays in predisposing the eggs to chromosome elimination. Aging of mothers prior to mating also results in a marked increase in the proportion of sons; since differential mortality may be ruled out by inspection of ovarian contents, earlier onset of chromosome elimination is believed to be responsible for the effect of aging on sex ratio.

835* Carlson, E.A., Southin, J.L. PRELIMINARY PSEUDOALLELIC ANALYSIS OF X-RAY INDUCED MUTATIONS AT THE DUMPY LOCUS IN D. melanogaster. Drosophila Inform. Serv. 33 (1959) 124-5.

A series of x-ray-induced dumpy mutations in D. melanogaster, obtained at doses of 4000 and 1000 r administered to mature spermatozoa, was examined for gross and minute structural damage to genetic material. A recombinational analysis method was applied in testing the mutant with its neighbouring genes for the presence or absence of crossing over. Data are tabulated and results are discussed. (TID-3098, 4092)

836 Carlson, E.A., Southin, J.L. COMPARATIVE MUTAGENESIS OF THE DUMPY LOCUS IN Drosophila melanogaster. I. X-RAY TREATMENT OF MATURE SPERM – FREQUENCY AND DISTRIBUTION.

Evidence is presented to support the view that the majority of x-ray-induced mutations at the dumpy locus are gene mutations not associated with multibreakage events. Complete mutations (those affecting the entire body) form a mixed class of breakage events and gene mutations. The mutation frequency of the dumpy gene was not altered when sperm bearing a pre-existing dumpy mutation were used for irradiation. Gross mutation detected at the clot locus is 1/10 that of the dumpy locus. Criteria are evaluated for determining the true gene mutation frequencies at both loci. The results of the x-ray analysis of the dumpy locus support a theory of mutagenesis proposed by Muller, Carlson, and Schalet (1961). (From auth.)

837 Carvalho, G., Cruz, M.P., da. DIFFERENCES IN SENSITIVITY TO GAMMA RADIATION IN Drosophila OF THE willistoni GROUP. AEC-TR-6429. n.d. no paging. (In Portugese).

Three morphologically similar strains of Drosophila were compared. Virgin females (100) of D. willistoni, D. equinoxialis, and D. paulistorum were exposed to a Co^{60} source for 2 min 6 sec so as to receive ~3000 r. Differences in radiation effects on viability, a sex-ratio factor, and response to different temperatures were found amongst the 3 species.

838 Crouse, H.V. X-RAY INDUCED SEX-LINKED RECESSIVE LETHALS AND VISIBLES IN Sciara (i.e. Bradysia) coprophila. Amer. Nat. 95, 880 (1961) 21-6.

A study was made of the sex-linked recessive lethal and visible mutations induced by x-rays in the sperm and oöcytes (first meiotic prophase) of S. coprophila. For sperm irradiated at 2000 r, 3000 r, and 4000 r the lethal rates obtained were 0.0136, 0.0303, and 0.0348 respectively. Sperm and oöcytes irradiated at 4000 r gave approximately the same lethal rate, 0.0348 versus 0.0437. On the basis of the experimental data the following interpretations have been made: (1) Sciara is not resistant to the mutagenic effects of x-rays. The low yield of visible mutations obtained repeatedly in this genus can be attributed to a number of factors, including the unusual mode of inheritance and sex determination found in these flies. (2) There is no correlation between the induction of chromosomal aberrations and the induction of sex-linked recessive lethals. When the latter are used as a criterion of sensitivity to x-rays, the response of sperm and oöcyte (first meiotic prophase) are not significantly different. When chromosomal aberrations are used as a measure of sensitivity, however, the sperm are found to be highly sensitive whereas the oöcytes are completely insensitive (zero aberrations). (From auth.)

839 Crouse, H.V. X-RAY EFFECTS ON SEX OF PROGENY IN Sciara (i.e. Bradysia) coprophila. Biol. Bull. 120, 1 (1961) 8-10.

X-ray experiments of 3 kinds were conducted on S. croprophila which clarify the mechanism of sex determination in this species. The data were interpreted to imply that irradiation can induce a sperm or oöcyte to transmit an irregular number of sex chromosomes to the zygote; if, following chromosome elimination from the embryonic soma, a viable somatic complement (XX or X0) results, the embryo will differentiate accordingly into female or male.

840* Di Pasquale, A. THE "BROWN SPOT" CHARACTER IN Drosophila melanogaster AND THEIR RESPONSE TO X-RAYS. Atti Ass. genet. ital. 5 (1960) 117-26. (In Italian, with English Summary).

Some preliminary observations concerning a new character of D. melanogaster consisting in brown spots appearing on the abdomen of the females, some days after birth are reported. The brown spots are restricted to the hypodermal cells of the pleurae. Size and number of spots per individual are variable. This character appears in all isogenic chromosomal combination involving the second chromosome, derived from the wild stock Aspra 52, which fails to show spots, and has a manifestation of tumours (60%). The spots appear some generations after the establishment of the isogenicity. Treatment of larvae and pupae with x-rays fails to induce the spots in the males, but increases the size of the spots. A possible cytoplasmic effect is discussed, as well as the connection between brown spots and tumours. (Auth.)

841 Edington, C.W., Epler, J.L., Regan, J.D. THE FREQUENCY-DOSE RELATION OF X-RAY-INDUCED Y-SUPPRESSED LETHALS IN Drosophila. Genetics 47 (1962) 397-406.

An investigation was made to determine the frequency-dose relations of total sex-linked recessive lethals as measured by the S-5 technique and the two major classes of lethals, orthodox and Y-suppressed, of which they are composed. It was found that orthodox lethals increase linearly with increasing dose. Y-suppressed lethals, which behave for the most part as V-type position effects and constitute a large fraction (83% at 1082r-17.3% at 4328r) of total lethals at all doses studied, increase more rapidly than expected on the basis of linearity. When orthodox and Y-suppressed lethals were combined, it was shown that the frequency-dose relation of total lethals deviated significantly from linearity. The significance of these dose-response relationships to recessive lethal origin has been discussed. (Auth.)

842 Edington, C. A STUDY OF GENE AND CHROMOSOME CHANGES INDUCED BY IONIZING RADIATIONS IN Drosophila melanogaster. (Abstr. B1D255) p.45 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

A study of the frequency of radiation- and chemical-induced fractional mutations in Drosophila is in progress. The utilization of special screening techniques allows the detection of F-1 females that are mosaic for sex-linked recessive lethal mutations. The mosaic females give rise to cultures in the F-2 generation that are scored as non-lethal cultures; however, an additional mating of the daughters present in these non-lethal cultures shows that some of the daughters are heterozygous for an induced lethal while their sisters are homozygous for the normal allele of the lethal. The average proportion of females that are heterozygous for a lethal from a mosaic F-1 mother can be used to estimate the probable number of basic strands in the chromosomes of Drosophila. In addition, studies are continuing on the investigation of the effect of the amount and distribution of heterochromatin in the X chromosome of Drosophila on the frequency of x-ray induced X-autosome translocations.

843* Falk, R. VIABILITY OF Drosophila HETEROZYGOUS FOR IRRADIATED CHROMOSOMES. Science 130, 3386 (1959) 1416.

Numerous lines were prepared such that they were originally homozygous and coisogenic for their second and their ve-marked third chromosomes, except for heterozygosity for the recessive marker st on their third chromosome. Half the lines had their ve st$^+$ chromosome irradiated with a dose of 24 000 r, given to the spermatogonia. By backcrossing these lines to a coisogenic stock, homozygous for ve st, for a number of generations, viability could be measured. Viability of control homozygous lines was compared with that of the lines having one irradiated chromosome superposed on the same otherwise homozygous background. Viability of heterozygotes having one irradiated chromosome on a largely heterozygous but uniform background was also measured. Although many recessive lethal as well as detrimental mutations were induced, no increase in the average viability of the isogenic flies could be demonstrated as a result of the heterozygosity caused by the radiation-induced mutations.

844 Falk, R. ARE INDUCED MUTATIONS IN Drosophila OVERDOMINANT? II. EXPERIMENTAL RESULTS. Genetics 46 (1961) 737-57.

It was intended to investigate whether induced mutations when in heterozygous condition and unselected can increase the average viability of an otherwise homozygous genotype. The design of the experiment was such as to afford every chance for an induced increase in viability to be detected. More than 60 lines were prepared, each having an irradiated third chromosome marked with the gene ve, carried along with a ve st marked chromosome (coisogenic – except for the st locus and its vicinity – with the ve-marked chromosome before its irradiation), and homozygous as well as isogenic with respect to the second chromosome genes. A similar number of control lines, identical except for the irradiation, were also secured. The irradiation delivered to the treated lines comprised 6 doses of 4000 r each, given to males at 5-d intervals. The irradiated males were kept for 15 d after the last irradiation before deriving from them the offspring studied, so that practically only sperm that had been irradiated at spermatogonial stages was utilized. The reduction of viability caused by the presence in heterozygous condition of radiation-induced mutations ranged from 0-3%. Results also support the notion that non-lethal deleterious mutants are on the average relatively more dominant than lethals. The maximum increase in viability was found to be even lower than the minimum increase possible according to Wallace (Radiation, Genes, and Man. Henry Holt and Co., New York 1959) in which he found an average increase of 1.5% in the viability of lines heterozygous for radiation-induced mutations. The possibilities of inducing many overdominant mutations and maintaining them in a population are discussed.

845 Falk, R., Rahat, A., Himel, N. THE VIABILITY OF HETEROZYGOTES FOR X-RAY INDUCED MUTATIONS. (Abstr.) p.153 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Irradiation is known to induce many mutations deleterious to homozygotes and hemizygotes. The effect of these mutations in the heterozygous state (especially of the very common class, with only slight effects on viability in homozygotes) is of major importance for their survival and for the dynamics and evolution of populations. It has sometimes been suggested that x-ray-induced mutations would be neutral in heterozygotes, or might even confer increased fitness on highly inbred individuals heterozygous for them. The X-chromosome of Drosophila melanogaster is under study to determine, quantitatively, the viability of heterozygotes for x-ray induced mutations in spermatozoa and spermatogonia. The average degree of expression in the heterozygotes (dominance) of the deleterious effects detected in the hemizygotes has been calculated. Preliminary results confirm previous observations that the deleterious effect of x-ray induced mutations is also detectable in the heterozygotes. This seems to be so even for the range of mutations only very slightly affecting viability of the hemizygotes. A more detailed study on the correlation between the effect of a mutation on viability in the hemizygotes and that in the corresponding heterozygotes might lead to a better insight into the dynamics of natural and irradiated populations. Special attention is being paid to mutations which might, at least under certain conditions, improve viability.

846 Falk, R., Rahat, A. THE DEPENDENCE OF VIABILITY EFFECTS CAUSED BY IRRADIATION ON THE TYPE OF MATING. Proc. nat. Acad. Sci., Wash. 49, 3 (1963) 292-8.

The daughters of x-irradiated males and unirradiated control males were mated individually to 2 types of males of Drosophila melanogaster. The viability of males hemizygous for the irradiated chromosomes and of females heterozygous for the irradiated chromosomes was determined together with the corresponding control values. While the viability of males hemizygous for irradiated chromosomes was always reduced, the viability of females heterozygous for irradiated chromosomes was either reduced or increased, depending on the type of mating. Intraculture competition differences were demonstrated to be responsible for the difference between matings. The heterotic effect was observed whenever the females heterozygous for the irradiated chromosome were able to replace the decline in the number of males hemizygous for irradiated chromosomes. The observed heterosis was therefore spurious, in that it was not in fact the effect of a viability of the heterozygote superior to that of either homozygote. It is suggested that some previous reports on differences in mutability between types of crosses or on heterosis of flies heterozygous for induced mutations were also caused by intraculture competition. (Auth.)

847 Falk, R., Ben-Zeev, N., Baker, S. EFFECTS OF IRRADIATED CHROMOSOMES ON VIABILITY IN HETEROZYGOTES AND HEMIZYGOTES. (Abstr. 5.55) p.74 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

Drosophila males were irradiated with an x-ray dose of 2000 r and mated according to a design that permitted the determination of viability effects in both the heterozygotes and hemizygotes carrying the irradiated X-chromosome. Apart from the induced lethals and semi-lethals, the milder quasi-normal viability mutations could also be detected in the hemizygotes for irradiated chromosomes. In crowded cultures, when deleterious mutations caused a decline in the number of males hemizygous for the irradiated chromosome, the remaining genotypes competed for the available space. If the efficient competitors were heterozygous for an irradiated chromosome as well, the induced viability effect was offset in the final outcome by their advantage in competition. The heterozygotes for irradiated chromosomes thus exhibited a spurious increase in viability as compared with their controls which carried unirradiated chromosomes. When intra-culture competition was kept at a minimum it could be demonstrated that the induced mutations had an adverse effect on the viability of hetrozygotes. The heterozygotes carrying semi-lethal mutations were the most seriously affected. The heterozygotes for quasi-normal chromosomes were considerably less viable than the controls, their viability being reduced at least as much as that of heterozygotes for lethals.

848 Fattig, W.D. A CHROMATOGRAPHIC AND SPECTROPHOTOMETRIC INVESTIGATION OF FLUORESCENT SUBSTANCES OCCURRING IN CERTAIN EYE-COLOR MUTANTS OF Mormoniella vitripennis (Walker).

A radiation-induced eye-colour mutant, su, which produces oyster-eyes in adult M. vitripennis has been shown to occur at the R-locus. Within the R-locus it occurs in a cistron other than S, and probably occurs in the O-cistron. One and 2-dimensional chromatography reveal that 2 R-locus mutants, su and scarlet-DR, both accumulate a blue-green fluorescent compound, designated 4b. This compound is present, but is not accumulated, in wild type organisms. Although phenotypic complementation occurs between su and st-DR, chemotypic complementation does not occur either in vitro or in vivo. Two possible explanations for these results are presented. The black (bk) mutant of Mormoniella accumulates 2 fluorescent substances. Hypotheses to explain these accumulations are proposed. In all, 9 fluorescent compounds occur on chromatograms of Mormoniella extracts. Ultraviolet absorption spectra for 3 of these substances are presented. One of these substances is found in both Mormoniella and Drosophila, and has not been reported in Drosophila before. (From abstr.)

849 Friedman, L.D. X-RAY INDUCED SEX-LINKED LETHAL AND DETRIMENTAL MUTATIONS AND THEIR EFFECT ON THE VIABILITY OF Drosophila melanogaster. Diss. Abstr. 21, 10 (1961) 2861.

The total decrease in viability in irradiated chromosomes can be separated into two components which will be called the lethal (L) and detrimental (D) genetic loads. The D : L ratio was found to be 0.125. This is a low value, but in much better agreement with the recent studies than the earlier ones. The present results together with those of Käfer suggest that the initial D : L ratio is much lower than reported by Timoeff-Ressovsky and Kerkis. The reasons for this discrepancy are not clear, but the newer results remove much of the basis for Greenberg and Crow's suggestions. (See their published work, as cited in the thesis).

850 Friedman, L.D. X-RAY INDUCED VIABILITY MUTANTS IN Drosophila melanogaster. (Abstr.) Genetics 46, 8 (1961) 865.

In order to determine the relative importance of lethal vs. detrimental mutations Muller-5 (Basc) and wild type males segregating from the same culture were irradiated with 1000, 3500, and 7000 r. These were mated with Basc/+ females from the same culture, and the F_1 heterozygous females mated individually with asc males which are the same as Basc except for the absence of Bar. The F_2 male progeny were counted, and the ratio of + to Basc where the Basc chromosome had been irradiated was compared with those where the + had been irradiated. The lethal frequency was .029/1000 r for the Basc chromosome and .020/1000 r for Canton-S, a significant difference – Early studies by Timoffeef-Ressovsky and Kerkis showed a high fraction of the total genetic load to be due to detrimentals, whereas the more recent work of Kafer showed a smaller fraction. Our results are in close agreement with Kafer, the ratio of the detrimental to the lethal load being 0.125. In our studies a lethal was defined as having less than 10% of the normal viability. The results indicate that either very few detrimental mutations are induced or that individually they have very minor effects.

851 Frye, S.H. STRUCTURE OF "YELLOW" MUTATIONS INDUCED BY X-RAYS OF SCUTE^8 CHROMOSOMES OF DIFFERENT GERM CELLS IN Drosophila melanogaster. (Abstr.) Genetics 46, 8 (1961) 965-6.

577 "yellow" mutations induced by x-rays in scute^8 chromosomes of different germ cells were genetically analysed to determine their qualitative structure. Order of the loci is assumed to be IJ1, y, ac, and bb. The symbol + indicates the normal allele while - indicates an affected or deficient locus, the locus involved being indicated by the position of the symbol. An additional lethal (if present) somewhere to the right of bb is symbolized as - in the 5th position. The following are structural frequencies of the "yellow" mutants x-ray induced in oögonia, oöcytes, and mature sperm, respectively: - - - + 4, - - - + - 1 (total 5); - - - + 14, - - - - 5, - - - - - 1, - - - + - 3, + - - + 5, + - + + 3, + - - + - 3, + - - - - 1 (total 35); - - - + 374, - - - - 43, - - - - - 31, - - - + - 16, + - - + 41, + - + + 22, + - - + - 4, + - + + - 1, + - - - 2, + - - - - 3 (total 537). - All - - (±) (±) chromosomes of oögonia and oöcyte "yellows" were tested for translocations involving the 4th chromosome (Cat$^+$). None of the oögonia "yellows" were capped by Cat$^+$(IVR). Two of the oöcyte "yellows" (symbolized - - - -) were capped by Cat$^+$(IVR). Mature sperm "yellows" were tested for the 2nd (IIL, IIR) and 4th chromosome tips. Twenty-two cases were found. Tips from IIR (11/22 exceeded all other autosomal tips detected. All yellow half-translocations were deficiency half-translocations. – The structure of breakage "yellows" in scute^8 chromosomes is not dependent upon either the x-ray dose (even 10 spontaneous "yellows" were classifiable as either minute or gross structural changes) or the germ cell stage. – The means by which x-ray induced (and possibly spontaneous) breakage and intragenic mutation can be separated is still not available. A consideration of the frequency, functional and structural types of chromosome breaks and their interactions may yield a more realistic and unifying approach to transmissible changes (both forward and back) than the concept of intragenic mutation.

852 Frye, S.H. FURTHER INVESTIGATION CONCERNING THE COMPLEX PHENOTYPIC LINEARITY OF YELLOW MUTANTS X-RAY INDUCED IN SCUTE^8 CHROMOSOMES OF Drosophila. p.204 in "XVI International Congress of Zoology, Washington, 20-27 August 1963. "Vol.II". Moore, J.A. Ed., Washington D.C., XVI International Congress of Zoology.

Young scute^8 Bar males were x-rayed at a relatively high dose, 8000 r. Four post-treatment matings, or broods, were made every 24 h and consisted of treated males and virgin females containing the sex-linked marker, yellow body colour, and autosomal markers, echnoid eye, dumpy wing, and clot eye. Inseminated females from each of the four broods were transferred several times into fresh bottles. The treated males were removed from the fourth brood after 24 h and were discarded. Consequently, F_1 females were derived from eggs that had been fertilized by 1-d old, 2-d old, 3-d old, and 4-d old sperm from time of treatment. Exceptional yellow daughters were recovered among the expected F_1 Bar females. Simultaneous controls were run, and the total induced frequency was corrected. The total frequency of exceptional yellows from each (not all) of the 4 broods always fluctuated in the same direction, i.e., below the expected frequency for linearity (Brood I), above the expected frequency for linearity (Brood II), and below for Brood III. However, the totals of yellow mutants (from all 4 broods) induced in y^+ scute-8 chromosomes of mature and nearly mature sperm by 8000 r were found to exhibit approximately a linear dose-frequency relation as reported for lower x-ray doses (Frye, ibid). Possible mechanisms as to why the curve continues to rise are discussed. (From abstr.)

853 Glass, B., Ritterhoff, R.K. MUTAGENIC EFFECT OF A 5-r DOSE OF X-RAYS IN Drosophila melanogaster, Science 133 (1961) 1366.

Minute bristle mutations, dominant mutations which occur at > 50 loci in the Drosophila genome, served as the basis of scoring. Both parents were irradiated with 5 r, so that the effective dose to the offspring was 10 r. A highly significant reduction in the number of progeny from the irradiated parents, amounting to 1.3% was found; other visible mutations were in excess, though not significantly. It may be tentatively concluded that an acute dose of 5 r produces mutations, at a rate linearly proportional to the effects at 1000 r and 2000 r, in the mature gametes of both sexes.

854 Glass, H.B. THE ACTION OF RADIATION AND OTHER MUTAGENIC AGENTS (1) IN INDUCING MUTATION IN Drosophila FEMALES, AND (2) IN CONTROLLING THE ACTION OF SPECIFIC GENES RESPONSIBLE FOR SUPPRESSING UNCONTROLLED GROWTH. TID-11809, Johns Hopkins Univ., Baltimore. 1961. p.7.

Results are summarized from a study on the effect of a 5-r dose of x-radiation on the induction of mutations in D. melanogaster. Results are also summarized from tracer studies on metabolic pathways involved in the formation of brown-spot eye pigment and the suppression of tumour genes in D. melanogaster. (NSA 15:1961, 12717)

855 Glass, H.B. THE ACTION OF RADIATION AND OTHER MUTAGENIC AGENTS (1) IN INDUCING MUTATION IN Drosophila FEMALES, and (2) IN CONTROLLING THE ACTION OF SPECIFIC GENES RESPONSIBLE FOR SUPPRESSING UNCONTROLLED GROWTH. Report Covering 9-Year Period, May 1, 1953 - April 30, 1962. TID-15001, John Hopkins Univ., Baltimore. 22p.

Studies of the comparative mutagenic effects of ionizing radiations on males and females of D. melanogaster are described. Sex-linked recessive lethal mutations were induced in nitrogen, air, and oxygen at doses of 1000, 2000, 3000, and 4000 r. The frequencies of mutations obtained in spermatozoa were uniformly about 1/3 higher than the frequencies obtained for the same dose and condition of atmosphere in mature oöcytes. The relative frequencies of recessive autosomal lethals in mature male and female germ cells were identical with the relative frequencies of sex-linked recessive lethals. In studies of point mutations and deficiencies involving specific loci, the rates in the male germ cells exceeded those in the female germ cells by a proportion equal to that found to apply to autosomal and sex-linked recessive lethals. Fertility was lost in both males and females when they were x-rayed as 80-h-old larvae and bred upon emerging as adults. Females recovered their fertility rapidly but the males did so at a much slower rate. A study was also made of the effects on the life span of two different mating regimens.

856 Glass, B. THE MUTAGENIC EFFECT OF A 5-r DOSE OF X-RAYS. Drosophila Inf. Serv. 36 (1962) 65-6.

857 Глемобицкий, Я.Л. Абелева, Э.А., Лапкин, Ю.А. ВЛИЯНИЕ ФРАКЦИОНИРОВАНИЯ ДОЗЫ ГАММА-ЛУЧЕЙ НА ЧАСТОТУ ВОЗНИКНОВЕНИЯ МУТАЦИЙ В СПЕРМАТИДАХ у Drosophila melanogaster. Радиобиология 1, 1 (1961) 120-2.

Glembotskiĭ, Ya. L., Abeleva, E.A., Lapkin, Yu.A. EFFECT OF FRACTIONATION OF THE GAMMA-RAY DOSE UPON THE FREQUENCY OF OCCURRENCE OF MUTATIONS IN SPERMATIDS OF Drosophila melanogaster. Radiobiology 1, 1 (1961) 361-72. JPRS-10170, 18 Sep. 1961. Translation from Radiobiologiya 1, 1 (1961) 119-22.

The linear dose-frequency dependence of recessive sex-linked lethal mutations induced by γ-rays in Drosophila spermatids was found to be affected in the range from 1000 r to 2000 r, even when the 2000 r-dose was fractionated, with a 3 h-interval between each 1000 r. A similar change in the relationship occurred for dominant lethals. The validity of Russel's hypothesis to explain the phenomenon is challenged, i.e. that the death of the most mutable cells accounted for the observed retardation in the expected increase in mutation-frequency with dose.

858 Glembotskiĭ, Ya.L., Abeleva, E.A., Lapkin, Yu.A., Parfenov, G. P. EFFECT OF FACTORS OF COSMIC FLIGHT ON FREQUENCY OF APPEARANCE OF RECESSIVE LETHAL MUTATIONS IN X-CHROMOSOME OF Drosophila melanogaster. p.303-24 in FTD-MT-62-78, n.d. Translation.

Investigations of two strains of D. melanogaster established a mutagenic effect for the complex of factors encountered during space flight. Lethal mutations were checked cytologically, and 20 were identified as point mutations. It was concluded that these were induced by cosmic radiation. Vibration, acceleration, and weightlessness may influence the genetic effects of radiation during space flight. (NSA 17:1963, 35279)

859 Glembotskiĭ, Ya.L., Abeleva, E.A., Lapkin, Yu.A. THE EFFECT OF SMALL DOSES OF IONIZING RADIATION ON THE FREQUENCY OF OCCURRENCE OF SEX-LINKED, RECESSIVE, LETHAL MUTATIONS OF Drosophila. (Abstr.) Soviet Bloc Mainland China Tech. J., Ser. VI Bio-Sci. 61-11 145, 26 (1963) n.p. English abstract.

The preliminary results of experiments to study the effect of 20 r doses of radiation on the frequency of sex-linked, recessive lethals, in relation to (a) type of radiation γ-rays or high speed neutrons; (b) radiation intensity - single or repeated doses; (c) gamete development – mature sperm or spermatids; (d) interstrain differences in spontaneous mutation rate. It is stated that little work has been done on the effects of sub-25 r doses, especially regarding the existence of a threshold and accumulative effects. The experiments were carried out on Д-18 and Д-32 (D-18 and D-32) Drosophila lines, differing considerably in spontaneous mutation rate. Spontaneous and induced lethals were detected by the Muller-5 method. Co^{60} γ-rays were delivered at 0.93 r/min. Experiments with high-speed neutrons began in May 1960, using a 1000 kV reactor, the dose intensity being 115 r/h. The results refer only to experiments with D-32 line. The authors found that 5-r doses of γ-radiation increased the frequency of recessive lethals in sperm and spermatids and repeated radiation produced a cumulative, mutagenic effect. The relative frequency of recessive lethals per radiation induced by repeated 5 r γ-radiation agrees with the data of other authors using higher single doses. The mutagenic effect of high-speed neutrons is 1 1/2 - 2 times greater than that of γ-rays. Spermatids had a higher mutation rate than sperm, with both types of radiation. No threshold effect was demonstrated and it is suggested that, should a threshold be detected, it will be specific to the type of radiation, type of mutation, stage of gametogenesis, and the organism. The danger to human germinal cells of low doses of γ-rays, and especially, highspeed neutrons is stressed. There are 3 tables. (Auth.)

860* Green, M.M. COMPARATIVE MUTABILITY OF WILD-TYPE ISOALLELES AT THE WHITE LOCI IN Drosophila melanogaster. Genet. Res. 1, 3 (1960) 452-61.

The frequency and type of x-ray induced mutations at the w loci in the Canton and Oregon wild-type stocks was studied. No differences in the mutation rates were found. A significant difference was found in the mutation rates of recombinationally separable segments of the w loci. (Auth.)

861 Green, M.M. BACK MUTATION IN Drosophila melanogaster. I. X-RAY-INDUCED BACK MUTATIONS AT THE YELLOW, SCUTE AND WHITE LOCI. Genetics 46 (1961) 671-82.

The induction of back mutations by x-rays was studied using 7 independent sex-linked mutants in D. melanogaster and irradiating attached X females. Significant increases in the back mutation rates of the mutants y^2, sc, and w^a were found. No evidence was found that the back mutations were caused by recombination events or mutations to independent suppressors. Crossing over tests indicate that the back mutations are not associated with chromosome rearrangements. The problem of x-ray induction of back mutations is briefly discussed. (Auth.)

862 Green, M.M. BACK MUTATION IN Drosophila melanogaster. II. DATA ON ADDITIONAL YELLOW AND WHITE MUTANTS. Genetics 47 (1962) 483-8.

Further attempts to obtain x-ray-induced mutations at the yellow and white loci in D. melanogaster are reported. Of five independent white mutants tested, only w^{bf} yielded back mutants. Of the five yellow mutants studied, a single apparent reversal of the x-ray-induced mutant y^{59k} was found. The relationship of these data to previously reported back mutation data in Drosophila are discussed. (Auth.)

863 Gunson, M.M. CYTOLOGICAL EFFECTS OF X-RAYS IN RELATION TO DOSE-RATE IN Drosophila melanogaster. Amer. Nat. 96, 891 (1962) 347-52.

A cytological study has been made of 2 groups of sex-linked recessive lethals induced in spermatozoa of D. melanogaster by high and low intensity x-irradiation, the 2 dose-rates varying by a factor of 20. Although aberrations are found to be slightly more frequent in the high dose-rate group, no significant difference between the 2 series is apparent in this respect. The result of this cytological analysis is considered in relation to the question of an intensity effect in Drosophila. (Auth. summary)

864 Hannah-Alava, A. MUTATION RATES AT SPECIFIC LOCI IN Drosophila melanogaster. Period covered: November 1960 through April 1961. Supplementary Report for March and April 1961. TID-16428, Turku, Finland. Univ. 7p.

Progress is reported in studies on the genetic effects of x-radiation in Drosophila. Data are presented on radiation damage, as measured by mutation rates at specific visible autosomal loci, of male germ cells of two species of Drosophila. Emphasis was placed on the comparative mutation rates of gametes in different stages of maturation at the time of radiation exposure. (NSA 16:1962(28746)

865 Hannah-Alava, A. MUTATION RATES AT SPECIFIC LOCI IN Drosophila melanogaster. Final report November 1, 1960 through October 31, 1961. TID-16429, Turku, Finland, Univ. 31 Oct. 1961. 5p.

Effects of radiation were studied in terms of mutation rates at specific, visible, autosomal loci induced in male germ cells of different species of Drosophila, particularly with regard to different physiological states at the time of irradiation. The most satisfactory brood pattern proved mating individual males successively to 7-10 females per mating, on the 3rd, 5th, 7th, 10th, 12th and 14th day post-irradiation. A total of 61 recessive mutants at 9 loci were recovered in the experimental series, none in the controls. The difference in mutant incidence at the different loci is great enough to suggest that the loci are not mutating at the same rate. Different loci appear to have different mutation rates in different broods. The mutations in the 3rd chromosome were analyzed cytogenetically. 14 mutants at the in locus are being tested cytogenetically.

866 Hannah-Alava, A. MUTATION RATES AT SPECIFIC LOCI IN Drosophila melanogaster. Period covered: November 1, 1961 through April 1962. TID-16430, Turku, Finland. Univ. 7p.

The brood procedure was used for obtaining mutations. The percentage of fertile males was found to decrease progressively from brood 1 to 7 with the exception of brood 3 (6 to 8 d), which was lower than the last broods. The lowest number of offspring per male was found in the 3rd brood with a progressive increase from the 4th to the 7th broods. A progressive decrease in mutations from the 4th to the 7th broods was also found.

867 Hannah-Alava, A. RATES OF VISIBLE MUTATIONS AS RELATED TO THE MATURITY OF THE MALE GERM CELLS OF Drosophila melanogaster AT THE TIME OF RADIATION. (Abstr.) p.115 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 Aug. 1962". London, Silver End Documentary Publications, Ltd. 1962.

The effect of radiation damage, as measured by mutation rates at 10 recessive autosomal loci in D. melanogaster, was determined using the brood procedure to relate the temporal to the spatial pattern of spermatogenesis. Males, treated with 3000 r x-ray, were mated individually and sequentially to females with a recessively marked third chromosome, and the F_1 offspring heterozygous for the marked chromosome were inspected for phenotypic variants. Each variant was tested genetically for its heritability. As mutations at the specific third chromosome loci were mimicked by phenotypic dominant mutations and Minutes in the other chromosomes, mutation rates for these two types were also determined during the course of extraction and verification of the mutations at the specific loci. The rates were high for all 3 types of mutation in the first brood (1-3 d following treatment) but even higher in the next two broods (4-6 and 6-8 d). As the lowest fecundity was in the third brood, the rate of visible mutations appears to be higher in spermatids and probably also meiotic stages than in the mature sperm. The fourth brood (8-10 d) was characterized by a considerable decrease in mutation rates for all 3 types. In the 3 following broods (11-13, 13-15, and 15-d) the mutation rates dropped progressively suggesting that spermatogonia in different stages of maturation may have different sensitivities to radiation.

868 Hannah-Alava, A. THE RATES OF VISIBLE MUTATIONS IN SEQUENTIAL BROODS OR IRRADIATED Drosophila melanogaster MALES. (Abstr. 5.38) p.68 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

The brood pattern of recovered mutations was determined for three different types of visibles-dominants and Minutes in all chromosomes and recessives at specific third-chromosome loci – in the progeny of D. melanogaster males of two genotypes: wild-type, Oregon-RS, males (Exp.I) and males heterozygous for 12 third-chromosome recessive markers (Exp.II), mated singly and sequentially to females of an appropriate genotype for detecting mutations at specific loci and/or crossovers. The males in Exp.I were 2-24 h of age and in Exp.II 24-48 h of age at the time of treatment (3000 r hard x-rays) and initial mating. The sequential broods derived from these males, mated up to 24 d, totalled 94 081 and 42 951 F_1 offspring for the irradiated and control series respectively. Except for the first brood (1-3 d) in which there was a lower incidence of mutations in the progeny of the older males than the younger males, the curves of induced mutational response were not significantly different in the 2 experiments. In the broods following the period of excessive sterility (6-8 d) 113 mutations were recovered from 46 922 offspring of the irradiated males. The slopes of the curves in the premeiotic broods (11-24 d) suggest that one of the consequences of radiation of the early gonial stages is elimination of the germ cells with potential visible mutations to a greater extent than elimination of germ cells with either induced crossovers or recessive lethals with no visible phenotype.

869 Heidenthal, G. EMBRYONIC LETHALS INDUCED BY X-IRRADIATION OF FIRST MEIOTIC METAPHASE OÖCYTES OF Habrobracon. Genetics 47 (1962) 685-93.

Two methods have been used to study the frequency of various kinds of lethals induced by x-irradiation of Habrobracon oöcytes in 1st meiotic metaphase. The first method involved the study of hatchability of eggs laid by x-irradiated virgin females and by others which were x-rayed as virgins and then mated to untreated males prior to the egg-laying period (doses from 100 r to 1750 r). The second method involved tests of F_1 virgins which had developed from x-irradiated oöcytes which were later fertilized by untreated sperm (doses of 500 r, 1000 r or 1500 r). Comparison and analysis of the two methods indicate that the lethals detected by the first method are a mixed group, which includes recessive lethals persisting in heterozygous conditions among the adult F_1 females, and a group of lethals which express themselves when heterozygous in larval and pupal stages.

870 Hirobe, T., Yazaki, T. DIFFERENCE OF RADIATION SENSITIVITY BETWEEN MALE AND FEMALE UPON THE EGG COLOUR-SEX-LIMITED, IN THE SILKWORM. (Abstr.) Jap. J. Genet. 37 (1962) 386. (In Japanese).

871 Ikeda, H., Moriwaki, D. ON THE "FEMALE-PRODUCING FEMALE" IN Drosophila bifasciata. V. (Abstr.) Jap. J. Genet. 36 (1961) 381. (In Japanese)

872 Inagaki, E. THE COMPARISON BETWEEN WHOLE AND FRACTIONAL MUTATION RATE INDUCED BY X-RAYS IN Drosophila. (Abstr.) Jap. J. Genet. 37 (1962) 388. (In Japanese).

873* Indiana Univ. Foundation. Research Div., Bloomington. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN Drosophila. Progress Report on the past 12 months and Renewal Proposal for the period September 15, 1960 to September 14, 1961. TID-6042, 31 May 1960. 14p.

874 Indiana Univ. Foundation. Research Div., Bloomington. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN Drosophila. Progress Report on the past 12 months and Renewal Proposal for the period September 15, 1961 to September 14, 1962. TID-13002, 31 May 1961. 18p.

Results are reported from studies on the relation between the dose rate at which γ-radiation from a Co^{60} source is delivered and its effectiveness in inducing lethal mutations in oögonia of Drosophila melanogaster. Results are included from preliminary studies on dose rate effectiveness of neutrons in inducing lethals in oögonia of Drosophila, the relation between the dose of x-radiation and the frequency of non-disjunction in the germ cells of Drosophila females, and the genetic aspects of somatic damage induced by irradiation in Drosophila. Data are tabulated on the frequencies of recessive lethals induced with the X chromosome of Drosophila. A list is included of publications by staff members during the period covered. (NSA 15: 1961, 23288)

875 Ives, P.T. FURTHER TESTS OF MUTATION FREQUENCIES IN SUCCESSIVE SPERM BROODS AFTER 1 kr OF GAMMA RAYS. (Abstr.) Genetics 46 (1961) 873.

Virgin Oregon-R/hes males, irradiated at 48-60 h after eclosion, were mated singly to 6 vg se females daily. F_1 males were tested for Y, 2 and 3 chromosome translocations. A marked peak in frequency (10-15%) occurred in days 5 and 6 sperm, with < 1% in days 7-12. Oregon-R/rucuca males irradiated at 0-12 h showed a similar frequency pattern except that the peak (19%) appeared in day 7 sperm. That posteclosion age by itself did not cause this pattern change was shown by testing irradiated 0-12 h, 48-60 h and week old virgin Oregon-R/ruc-th (rucuca without th) males. Each age group showed a pattern like the 48-60 h Oregon-R/hes. Simultaneous tests of 0-12 h Oregon-R/rucuca and Oregon-R/ruc-th are in progress. — For tests of the T frequency in early vs. late emerging F_1 of irradiated males, flies from non-crowded cultures sired by day 5 sperm (24-h laying period) were collected daily. The frequency was only half as high in F_1 males emerging in day one (roughly 20% of the total F_1 male hatch) compared to later days none of which differed from each other. Parallel X-linked mutation frequencies in semisibling F_1 females collected daily and tested by Basc showed no differences between days. F_1 samples are routinely taken in standard mutation rate tests here when more than 95% of the flies have emerged.

876* Jackson, C.E. A MUTANT IN Anopheles gambiae. Trans. roy. Soc. Trop. Med. Hyg. 51 (1957) 294.

In order to obtain mutants with a view to establishing linkage groups in A. gambiae, about 275 males were exposed to a dose of 1000 r x-rays. This was done using 140 kV, mA5 for 10 mins 18 secs. These males were mated with unexposed, unfertilized females from the same colony, and the F_1 and F_2 females examined. Several females were found with 4 distinct bands on the palps as compared with the normal wild type 3-banded palp. An examination of 200 females of the parent colony showed no such 4-banded females. Taxonomically this 4-banding is characteristic of the variety A. gambiae melas.

877* Karlik, A. GENETICAL STUDIES WITH Drosophila ambigua Pom. Z. Vererblehre 89 (1958) 448-58. (In German).

5 sex-linked, 1 partially sex-linked and 13 autosomal genes are recognised from new mutations, mostly produced by x-rays. A linkage map for the X-chromosome is presented. Homologies between these genes and genes in other Drosophila spp. are discussed. (TID-3098, 4134)

878 LaChance, L.E., Hopkins, D.E. MUTATIONS IN THE SCREW-WORM FLY. J. econ. Ent. 55, 5 (1962) 733-7.

A search was conducted to find mutants useful for marker stocks. Flies scanned for mutations came from 3 sources: (1) untreated laboratory-reared flies, (2) progeny from irradiated normal parents, and (3) progeny from irradiated flies inbred for 2 generations. Nine mutations are described for Cochliomyia hominivorax (Coquerel): 7 are dominant, 5 affecting wing characteristics, 1 body colour, and 1 oral vibrissae; 2 are sex-linked recessives, 1 affecting body colour and 1 affecting wing venation. Pertinent genetic data are presented for each mutant stock.

879 Lee, W.R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. Progress Report for 1961 and Renewal Proposal of Contract for 1962. TID-14212, New Hampshire. Univ., Durham. 6p.

The spectrum of viability mutations ranging from dominant lethals to detrimentals in haploids that resulted from irradiating semen from a single haploid male was studied in the honey bee. From the decrease in viability of diploid progeny following irradiation of the spermatheca of the parental queen, it was calculated that one or more dominant lethals were induced in 60.8% of the sperm cells. In a separate test using the same dosage on an unrelated queen 60.9% dominant lethals were found. The values obtained by irradiating semen in the spermatheca of queens with 2000 r of 50 kV x-rays were equal to 2500 r applied to semen in the spermatheca of males. Recessive mutations and mutants with incomplete dominance were detected in haploid progeny of F_1 queens.

See also TID-4200,'abstr. B1D302.

880 Lee, W.R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. Progress Report. TID-17579, New Hampshire, Univ., Durham. 1962. 7p.

Results of experiments on partial-body irradiation of queen honey bees show that irradiating the segments III through V of the abdomen produces the same lethal effect as whole-body irradiation, whereas irradiating any other body region does not produce a significant amount of radiation deaths during the following three weeks. Apparently, irradiation of segments III through V of the abdomen prevents the replacement by cell division of the digestive cells lining the ventriculus, and the queen then starves for lack of proper digestion. It is concluded that variations in the normal rate of cell division in the ventriculus of various insects and in the length of time different species can go without food can explain the great variation in resistance of adult insects to irradiation. (NSA 17: 1963, 7799)

881 Lee, W.R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. NYO-2315-1, New Hampshire, Univ., Durham. 1963. 7p.

The frequency of recessive detrimental mutations expressed in the haploid drone honey bee was investigated and compared with recessive and dominant lethal mutations detected in the haploid drone and diploid worker. (See 880). A single queen was inseminated by a drone homozygous for 3 genetic markers. Viability of progeny was determined, and hybrid daughters bearing the genetic markers were stored in colonies. The spermatheca of the queen was then irradiated with 2600 r kVp x-rays. Morphological defects and viability were studied in progeny and grand-progeny. A total of 92 pairs was then tested during one season. Results showed that 60.9% of the sperm cells receiving radiation (out of 2996 tested) contained at least one or more dominant lethals. Correcting for the saturation effect on the assumption of independence of each dominant lethal, an average proportion of 0.94 dominant lethals were found per gamete. The average reduction in embryonic viability was 28%. The post-embryonic viability ratios showed a bimodal distribution, presumably due to point mutations. Forty percent (31/77 pairs of queens tested) contained 1 or more recessive lethals. Correcting for the saturation effect the frequency of recessive lethals is 0.51. Emphasis was also placed on the production of mutations in oögonial cells of queens so that mutations could be detected in the queen's haploid progeny. By means of partial body irradiation it is now possible to give doses as high as 5000 r to oögonial cells, and additional work on effects of dose fractionation on queen viability and sterility is in progress.

882 Lindsley, D.L., Camba, C., Warters, M. THE CORRELATION BETWEEN RADIATION-INDUCED MALE STERILITY AND RECIPROCAL TRANSLOCATION IN *Drosophila*. (Abstr.) p.153 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

It has been observed that males of *Drosophila melanogaster* that carry a reciprocal translocation between the X chromosome and chromosome II or III are frequently sterile. X chromosome inversions and insertional translocations, on the other hand, do not generally lead to male sterility; thus the sterility is not attributable to break-associated mutation or position effect, but is dependent on reciprocal translocation as such. The experiments to be reported were designed to answer two different questions: (1) What proportion of sex-linked male-sterile mutations are associated with T(X; A)'s? (2) What proportion of T(X; A)'s are male-sterile? A sample of 120 sex-linked recessive male sterilizing changes was induced with Cs^{137} γ-radiation and put into balanced lines. Each of these lines is being tested for the presence of a T(X; A) by three criteria; (a) Salivary chromosome analysis, (b) Incidence of primary non-disjunction of the X chromosomes in T(X; A)/FM6 females, and (c) linkage analysis. The results to date suggest that approximately 80% of all sex-linked recessive male steriles are associated with X-autosome translocations. A sample of 140 T(X; 2)'s and T(X; 3)'s was induced by x-rays in mature sperm and recovered from test crosses of daughters of the irradiated males. Of those which survive as males approximately 75% (88/116) are male-sterile.

883* Meyer, H.U., Muller, H.J. GENETIC EFFECTS OF HIGH DOSES OF X-RAYS IN OÖGONIA. *Drosophila Inform. Serv.* *32* (1958) 137.

884 Meyer, H.U., Muller, H.J. SIMILARITY OF X-RAY-INDUCED MUTATION RATE IN GONIA OF *Drosophila* FEMALES AND MALES. (Abstr.) Genetics *46*, 8 (1961) 882-3.

Early gonia are agreed to have the lowest x-ray-induced mutation rate of all germ cell stages of adult *D. melanogaster.* However, reports have disagreed concerning whether their rates are alike in both sexes. Our present experiments have investigated the frequency of second chromosome recessive lethals induced in early gonia of both sexes x-rayed simultaneously with 4000 r (100 kVp, 240 r/min). Lethals induced in coisogenized chromosomes carrying fes-ms-b-cn-sp, of flies heterozygous for Curly-Oster, were detected by "criss-cross sterility" tests improved since Muller's Drosophila Inform. Serv. description. Individually identified young females and males, breeding for 3 d just before irradiation, produced control progeny denoted "YFC" and "YMC", respectively, and, after a 10-d or 15-d post-irradiation period of active breeding, produced experimental progeny denoted "10FX," "15FX" and "15MX", respectively. As another control, "15MC", progeny were taken from other males, unirradiated, after breeding them as long as those irradiated. Determination of induced lethal rate was made unusually accurate by allelism tests of lethals derived from the same parent before and after irradiation, some spontaneous mutations being thereby excluded from the "rectified" experimental rate. Allelism tests also disclosed "clustering" within experimental or control sibships, thus permitting more accurate standard error determinations (Muller 1952, GSA Records). Harmonically weighted mean frequencies (Muller 1941, Am. Naturalist) of six such experiments gave, for "unrectified" controls: YFC (3159 chromosomes tested) 0.61 ± 0.16%; YMC (2718) 0.29 ± 0.11%; 15 MC (2282) 0.17 ± 0.08%. For "rectified" experimentals: 10 FX (1962) 6.3 ± 0.7%; 15FX (1441) 6.5 ± 0.6%; 15 MX (2029) 7.4 ± 1.2%. These results, which for oögonia concur with our previous X chromosome results, show no significant sex difference.

885 Moriwaki, D., Tobari, I., Kitagawa, O., Ohba, S., Tobari, Y., Ikeda, H., Ichida, H. A SHIFT OF SEX-RATIO IN THE PROGENY FROM IRRADIATED MALES IN *Drosophila melanogaster.* Preliminary Note. A/AC.82/G/L.731, United Nations Scientific Committee on the Effects of Atomic Radiation. December 1961. 4p.

The sex-ratio changes in the progeny of males irradiated at different stages of the germ cells in *D. melanogaster* were investigated. Using the isogenic Oregon-R wild strain, male flies of 4 ± 2 h-old were irradiated with 1000 r, 2000 r, and 3000 r and were crossed with the same wild type females of about 3 d-old. The sex-ratio changes were found to be dependent on the dose as well as the germ cell stage. The sex-ratio shifted to the lowest level in the group where progenies came from males of 6 to 8 d after irradiation. Each class sex-ratio was depressed in proportion to dose and the coefficient was 0.0237 per 1000 r on the average. (NSA 16 : 1962, 11426)

(Also published as abstract only, in Japanese, in *Jap. J. Genet.* *36* : 1961, 388).

886 Moriwaki, D., Tobari, I., Kitagawa, O., Ohba, S., Tobari, Y.N., Ikeda, H., Fayama, Y., Kirimura, N. A SHIFT OF SEX-RATIO IN THE PROGENY FROM IRRADIATED MALES IN *Drosophila melanogaster.* II. (Abstr.) *Jap. J. Genet.* *37* (1962) 399. (In Japanese).

887 Mukai, T., Chigusa, S. X-RAY INDUCED POLYGENIC MUTATION RATE IN *Drosophila melanogaster.* (Abstr.) *Jap. J. Genet.* *36* (1961) 388. (In Japanese).

888 Mukai, T., Yoshikawa, I., Chigusa, S. RADIATION INDUCED MUTATION RATE OF POLYGENES CONTROLLING THE STERNOPLEURAL BRISTLE NUMBER IN *D. melanogaster.* (Abstr.) *Jap. J. Genet.* *37* (1962) 400. (In Japanese).

889 Mukai, T., Chigusa, S. RADIATION-INDUCED MUTATION RATE OF POLYGENES CONTROLLING THE NUMBER OF STERNOPLEURAL BRISTLES IN *Drosophila melanogaster.* *Ann. Rep. nat. Inst. Genet., Mishima. 1961.* *12* (1962) 83-5.

890 Müller, I., Löbbecke, E.A., Oltmanns, O. DOSE EFFECT CURVE OF SOMATIC MUTATIONS IN *Ephestia kühniella Z.* FOR LOW DOSE-RANGE (0-200 r). *Nature*, Lond. *194* (1962) 783-4.

Groups of *Ephestia kühniella Z.* (meal moth) pupae were irradiated with 0, 10, 20, 40, 80, and 200 r x-rays and both wings of each individual examined for scale mutations. The results for the most frequent type of mutants (ES 1) show that in the range of 20 to 1000 r the mutation frequency is proportional to the square of the dose, whereas for 0 and 10 r this relation no longer holds good. (NSA 16 : 1962, 20281)

891 Muller, H.J., Falk, R. ARE INDUCED MUTATIONS IN *Drosophila* OVERDOMINANT? I. EXPERIMENTAL DESIGN. *Genetics* *46* (1961) 727-35.

The background of the problem of overdominance and the plan of experiments to test for overdominance of induced mutations are presented. For experimental details, see 844.

892* Nelson-Rees, W.A. A STUDY OF SEX PREDETERMINATION IN THE MEALY BUG *Planococcus citri* (Risso). *J. exp. Zool.* *144*, 2 (1960) 111-37.

An investigation of sex pre-determination was initiated in an attempt to elucidate the mechanism ultimately responsible for sex determination in this and other coccids of the lecanoid section of the superfamily. The life cycle and the behaviour of the mealybug in culture on potatoes are described. Survival curves of offspring (% of each sex) following pre-mating irradiation (1000 and 2000 r x-rays) of mothers of various ages indicated a differential sensitivity of eggs which were to yield either male or female offspring. Daily laying patterns of treated females indicated that aging of the female prior to mating changed the nature of the sensitivity of ovarioles at the time of treatment to x-ray-induced lethality and thus altered the sex ratio of the total surviving offspring. Whereas young females readily supported the development of triploid females (31-35% of control females) through utilization of polar body fusion nuclei when they were mated to males previously treated with high dosage γ-irradiation (60 000-120 000 rep), aged females did so to a lesser extent (10%) or not at all. It is believed that the sex of the embryo is controlled by the stage of development of the ovarioles, i.e., (1) the stage in meiosis of the oöcyte, and (2) the nature of the egg cytoplasm at the time of fertilization. (From auth. summary)

893 Nirula, S., Swaminathan, M.S., Natarajan, A.T., Sharma, R.P. INCIDENCE OF MUTATIONS IN *Drosophila melanogaster* RAISED FROM FLIES FED ON IRRADIATED MEDIUM. (Abstr. 5.34) p.66-7 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Earlier studies at the Indian Agricultural Research Institute on the effects of culture media, potato mash and fruit juices irradiated with ionizing radiations on mitosis in root meristems of barley, *Vicia faba* and onion grown on them have revealed that such irradiated products may have radio-mimetic effects. In view of the obvious bearing of these data on assessing the wholesomeness of food material sterilised through ionizing radiations, a study was initiated in *D. melanogaster* to ascertain whether the mutational load is enhanced in flies fed with irradiated food. The basic medium consisting of glucose agar and yeast is irradiated with 150 krad of γ-rays (sterilizing dosage) at a 160-c-Co^{60} source. Young Oregon-K flies (soon after emergence) are fed on this irradiated medium. The flies are allowed to breed and parent flies are killed about 7 d later. The male flies which emerge out of the larvae fed exclusively with irradiated food are then used for conducting M-5 tests on normal culture medium for further F^1 and F^2 breeding. The experiments have been repeated thrice. Sex-linked recessive lethals have been found only in the families derived from the irradiated medium-series (6.44%). A wide range of phenotypic changes was a striking feature of the F$_2$ families from the irradiated medium cultures (their frequency ranging from 0.13-0.37% against 0.018-0.095% in control on population basis). Some of the mutant flies, viz. curly wings, yellow body, and another with dominant wing mutation were found to breed true. A few changes like half thorax, rotated abdomen and absence of neck belong to the non-inherited group of abnormalities of Morgan (Bridges, and Sturtevant 1925) they were observed only in the irradiated medium series. The implications of these studies will be discussed.

894 Nur, U., Chandra, H.S. INTERSPECIFIC HYBRIDIZATION AND GYNOGENESIS IN MEALY BUGS. Amer. Nat. 97 (1963) 197-202.

Gynogenetic females are known to develop after heavy doses of paternal irradiation in Planococcus citri (Risso). In attempts to induce gynogenesis 90 000 rep (from a Co^{60} source) were administered to males of Phenacoccus gossypii Towns and Ckll. and Pseudococcus gahani Green, and 70 000 rep to Pseudococcus obscurus Essig. The first two attempts failed. However, gynogenetic Planococcus citri daughters were obtained after Pl. citri females were mated to irradiated Ps. gahani males.

895 Purdom, C.E., McSheehy, T.W. DOSE-RATE AND THE INDUCTION OF MUTATIONS IN Drosophila. (Abstr.) Int. J. Rad. Biol. 6, 5 (1963) 491.

The lower efficiency of low-dose-rate irradiation on the induction of mutations in immature germ-cells, as discovered by W.L. Russell and his colleagues in the mouse, has not been demonstrated conclusively in other higher organisms. Some reports of studies in Drosophila and Bombyx claim a dose-rate effect, but in each case there are reasons for doubting an exact parallel with the phenomenon in the mouse. An early experiment by the present authors gave some evidence for a dose-rate effect in spermatogonia of Drosophila; this result however, could not be confirmed. The present paper deals with a continuation of these dose-rate studies, comparing dose-rates of 0.05, 0.5 and 5.0 rads/min. Information was obtained on the induction of second chromosome recessive lethal mutations in spermatogonia and other germ-cell stages in the testis. There was no evidence of a dose-rate effect in any of these male germ-cells.

896 Puro, J.A. TEMPORAL PATTERN OF THE EARLY STAGES OF SPERMATOGENESIS OF ADULT Drosophila melanogaster MALES AFTER TREATMENT WITH X-RAYS. (Abstr.) p.116 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

Adult males of D. melanogaster were treated with 3000 r x-rays and then mated individually to virgin females during the whole period of fertility of the male to obtain sequential broods from cells in successively younger stages of spermatogenesis at the time of irradiation. Studies were made of third chromosome lethal and visible mutations in the broods, following the period of maximum sterility, i.e. the third brood (6-8 d after irradiation). Clusters were detected by cross-testing mutations from the same male for identity. Using the total size of clusters (as measured by the number of identical mutations found) and the relative size of clusters (calculated as percentage of identical mutations from the total tested in a brood) as a criterion, the spatial pattern was related to the temporal pattern of early spermatogenesis. The results suggest that mutations occurring in the young spermatogonia are available much earlier than has been supposed previously. The sperm available at the time of highest fecundity following the sterile period seem to originate from primordial cells. The data suggest that the secondary gonia at the time of irradiation have a rather limited period in the brood pattern.

897 Saul, G.B.II. HAPLOID INTERSEXES IN Mormoniella. Genet. Res. 3, 3 (1962) 242-7.

Intersexes were found in a culture containing progeny of an unmated female which had arisen from the cross of oy-NH females with x-rayed wild-type males. Genetic evidence indicated that the intersexuality was due to mutation, and not to chromosomal aberration. The intersexes showed a gradient from anterior maleness to posterior femaleness, and were less masculinized than similar types reported in Habrobracon juglandis. (Auth.)

898 Shiomi, T., Inagaki, E., Tachibana, H., Nakao, Y. MUTATION RATES AT LOW LEVEL IRRADIATION IN Drosophila melanogaster. (A Preliminary Report). A/AC.82/G/L.734, Japan. National Inst. of Radiological Sciences, Tokyo. Dec. 1961. 7p.

Preliminary results of studies in D. melanogaster led to the conclusion that there is a linear relation between mutation rates and radiation dose down to 8 r. Sex-linked recessive lethal mutations were used as indicators of mutation induction. No evidence was seen of a threshold dose in genetic effect for doses of x-radiation down to 8 r. (NSA 16:1962, 11427)

(Also published as abstract only, In Japanese, in Japan. J. Genet. 36, 1961, 395)

899 Shiomi, T., Inagaki, E., Tachibana, H., Nakao, Y. MUTATION RATES AT LOW LEVEL IRRADIATION IN Drosophila melanogaster. (Abstr.) p.198 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The study was aimed at testing whether a linear relationship (down to 8 r) holds for sex-linked recessive lethals in Drosophila. Methods and materials used were based on data obtained by Spencer and Stern (1948). A wild-type Canton-S strain was used which was isogenized before the experiment and again every 4 months. About 400 one-week-old males were irradiated together in each experiment. The doses used were 8, 15 and 25 r. The results are based on 500 000 chromosomes.

900 Stern, C. THE CELL LINEAGE OF THE STERNOPLEURA IN Drosophila melanogaster. Devl. Biol. 7 (1963) 365-78.

Larvae of D. melanogaster were irradiated with x-rays to induce somatic crossing over resulting in genetically marked mosaic areas. Mosaic sternopleural sclerites were associated with mosaic mesonota in frequencies compatible with random association. Association of mosaic sternopleurae and mosaic legs was significantly more frequent than accountable by chance. It is concluded that the sternopleura is always derived from the ventral, not from the dorsal, disk. Apparently differing results of earlier authors are reinterpreted in terms of embryonic indetermination as contrasted to larval determination of prospective imaginal areas. (Auth.)

901 Stern, C. RADIATION AND MUTATION RATE. (Abstr. B1F1114) p.73 in "Research and Development in Progress, Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

The prime object of this project is the relationship between radiation and mutation rate. Much effort is on spontaneous mutation rates, the analysis of which includes small point mutations as well as chromosome aberrations. Work in progress is concerned with further studies of the intersex mutant, induction of mutations and mitotic crossing-over by heat shock, and problems of fertilization in Drosophila melanogaster. Developmental studies are centred on mosaic types produced by irradiation and also on gynandromorphic and mosaic types produced genetically.

902 Swaminathan, M.S., Nirula, S., Natarajan, A.T., Sharma, R.P. MUTATIONS: INCIDENCE IN Drosophila melanogaster REARED ON IRRADIATED MEDIUM. Science 141 (1963) 637-8.

An increase in the rate of mutation has been found in D. melanogaster reared on a basic medium that was irradiated with a sterilizing dose (150 000 rads) of Co^{60} γ-rays. In Muller-5 tests, sex-linked recessive lethals occurred only in the F$_2$ progenies of the male test flies obtained from breeding the parent flies on irradiated medium, while visible changes occurred in experimental cultures from both the control and irradiated media. The frequency of sex-linked recessive lethals was 0.35, 0.55, and 0.8% in 3 independent experiments. Visible changes were 2-6 times more frequent in the irradiated series than in the controls. (Auth. Summary)

903* Tsujita, M. X-RAY INDUCED MUTANTS IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 6 (1956) 63-5. (In Japanese).

904* Tsujita, M. STUDIES ON THE COMPLEX Nl-U-Di LOCI IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 7 (1957) 54-5. (In Japanese).

905* Tsujita, M. ON THE Nl^2 GENE BELONGING TO THE U-ALLELIC SERIES IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 8 (1958) 48-9. (In Japanese).

906* Tsujita, M. ON LETHAL Nl^1 AND Nl^2 EMBRYOS OF THE SILKWORM. Annu. Rep. nat. Inst. Genet. 9 (1959) 13-15.

907* Tsujita, M. GENETIC AND BIOCHEMICAL STUDIES ON THE NEW WHITE-EGG MUTANT IN THE SILKWORM. Annu. Rep. nat. Inst. Genet. 10 (1959) 13-5.

The mutant strain of the silkworm, w^{ox}, which exhibits a conspicuously transparent larval hypodermis and white eggs was obtained by x-ray treatment in 1954. The gene w^{ox} belongs to the Xth linkage group, and crossing experiments show it to be allelic to w^{ol} on chromosome Xth. Amounts of uric acid and isoxanthopterin produced in the hypodermis of larvae homozygous for w^{ox}, w^{f}, w^{ol} and of their hybrids were measured by a paperchromatographic method. The amount of uric acid in the hypodermal tissue of the w^{ox} homogeneous larvae is only 1/100 of that found in the w^{ol} larvae and 1/10 of that found in the od larvae. It is characteristic of the w^{ox} mutant that its amount of uric acid and isoxanthopterin are much smaller than in any other known mutant strain with transparent larval hypodermis. The change in amount of isoxanthopterin in the hypodermal tissue after injection of 2-amino-4 hydroxypteridine into the larval body cavity was investigated; the normal amount of isoxanthopterin reappeared after 24 h. It may be assumed that isoxanthopterin and uric acid newly produced in the hypodermal tissue penetrate into the body cavity, passing through cell membranes, and that the permeability of the substances is controlled by w^{ox} or w^{ol}.

908* Tsujita, M. X-RAY INDUCED Nl-TYPE MUTANTS OF THE SILKWORM. Annu. Rep. nat. Inst. Genet. 10 (1960) 16-17.

909 Tsujita, M. INVESTIGATIONS IN Nl TYPE LETHAL MUTANTS OF THE SILKWORM, WITH SPECIAL REFERENCE TO Nl, Nl^1 AND Nl^2 EMBRYOS. Jap. J. Genet. 36 (1961) 235-43.

A number of larvae showing the Nl phenotype were obtained by irradiation (8000 r x-rays) of $E^{H}E^{Kp}/E^{H}E^{Kp}$ individuals. The 3 Nl types, Nl, Nl^1 and Nl^2, were investigated. From crossing experiments, it is assumed that Nl mutants are caused by deficiencies in the part of the 14th chromosome which includes the oa locus and that the order of their relative lengths for the 3 types is $Nl > Nl^1 > Nl^2$. It was observed that embryos homozygous for Nl^1 die at a far more advanced stage than embryos homozygous for Nl and that the development of the embryos homozygous for Nl^2 advances still a little further. Thus, the difference in the extent of the deficiency in each of the three Nl mutants relates to the stage at which the respective homozygous embryos die. Spontaneous Nl type mutation occurs very rarely. However, it may be said from the present experiment that the frequency of the mutation increases strikingly as a result of irradiation with x-rays and that the extent of the deficiency in each of the Nl type mutants is not always the same. (Auth. summary)

910 Turku, Finland. Univ. THE MUTATION RATE AT SPECIFIC AUTOSOMAL LOCI IN DIFFERENT SPECIES OF Drosophila. 8 Month Progress Report. TID-13638. n.d., 10p.

The effects of radiation damage, as measured by mutation rates at specific visible autosomal loci, upon the male germ cells of Drosophila was studied with special emphasis upon comparative mutation rates of gametes in different stages of maturation at the time of radiation. Information on the brood patterns, and data on the kind and incidence of mutations as related to the brood patterns are summarized. A clearly defined reduction in number of offspring was found to occur in the 3rd brood (6 to 8 d following radiation) although the number of offspring is also considerably reduced in the 4th brood. The data point to a difference in mutation patterns as well as mutation rates for the 3 types of mutations. The numbers are large enough for the 1st 2 broods to make it highly probable that the difference between the mutants at specific loci, and the phenotypic dominants is more than just a quantitative difference. In respect to the gonadal periods, it appears that the mutation rate of the Minutes may be considerably higher than of the other types of mutations. It is also suggested that there may be a difference in mutation rates in gonadal cells in different developmental stages at the time of radiation. (NSA 16: 1962, 1465)

911 Valencia, R.M. SEX RATIO AFTER IRRADIATING FERTILIZED EGGS. Drosophila Inf. Serv. 36 (1962) 126.

912 Whiting, A.R. X-RAY INDUCED VISIBLE MUTATIONS IN Habrobracon OÖCYTES. Genetics 48 (1963) 491-5.

Dominant lethal, recessive lethal, and visible mutations occur in similar percentages in primary oöcytes of Habrobracon x-rayed in a resistant stage, first meiotic prophase ($LD_{50} = 12\,000$ r), and in a sensitive stage, first meiotic metaphase ($LD_{50} = 400$ r), after comparable doses, 25000 r and 1100 r respectively. (Auth.)

913 Whittinghill, M. STUDIES OF MUTATION AND OF RECOMBINATION IN THE SAME CHROMOSOMES OF IRRADIATED FEMALE Drosophila melanogaster. Final Report, Feb. 1, 1954-March 31, 1963. TID-18855, North Carolina. Univ., Chapel Hill. 1963. 34p.

The frequency of new lethal mutations was measured in chromosomes from isogenic sources which marked the whole length of the second chromosome pair of Drosophila melanogaster for the detection of crossovers simultaneously. Control heterozygotes and sisters given x-ray doses of 3666 or 4580 r provided chromosomes tested by the Sifter technique of Müller. Thereafter, each recessive lethal was further tested to determine the location of the new lethal, particularly as to whether it was in a region of crossing over or was outside any nearby region of exchange. In the chromosomes of eggs layed in the 1st 10 d post-irradiation the frequency of new recessive lethals decreased from a high of 9.8 ± 1.11% in the 1st 4-d-period to 4.7 ± 0.74 in the last 3-d period. These same chromosomes showed an increase in cross-over chromosomes available for testing, but only during the 2nd and 3rd breeding periods. Neither the cross-overs nor the lethals were linearly related to dose. Four fifths of the higher dose received during 4/5 of the maximum time of treatment produced less than 4/5 of the crossover frequency and of the lethal frequency of the 4580 r group. In spite of the 2 parameters changing in different directions with time the contingency Chi square showed an excess of chromosomes both lethal and crossover in the same region only in the spindle region and in a mid arm region. Studies were made of the mean viability and of its variability among the many non-lethals and lethals of the experiment. Viability was less after either of the irradiation doses. Variability was greater, as expected, among irradiated chromosomes and among crossover chromosomes. The immediate vicinity of the spindle attachment is evidently a very special region of the chromosome in regard to its responses to externally administered irradiation. (auth.)

914 Wild, A. A RED EYE COLOUR MUTATION IN Culex pipiens AFTER X-IRRADIATION. Nature, Lond. 200 (1963) 917-8.

Four 1-2-d-old males of C. pipiens were irradiated with a dose of 4000 r x-rays. While the normal eyes of the larvae, pupae, and adults appear pigmented dark brown to black, the mutation r causes a red eye colour in place of black. This mutant was isolated from F_3 cultures of 2 of the irradiated males. It could be demonstrated that r is inherited as a recessive, shows full penetrance and no variability of expression. Although white-eyed mutation is also sex-linked the two factors could be shown not to be multiple alleles.

915* Yamada, Y., Kitagawa, O. DOUBLING RADIATION DOSE IN GENETICS. Kokuritsu Idengaku Kenkyujo Nempo 10 (1960) 104.

After giving 500, 1000, and 1500 r to Drosophila the induced mutation rate was calculated from the regression. The estimation was 8.7×10^{-5}/r for the number of abdominal hair, and 3.5×10^{-5}/r for the number of chest hair. The doubling doses were estimated as 60 r for the former and 30 r for the latter. (Abstr. Japan Med. 2: (May 1962) No. 5))

916 Yamada, Y., Kitagawa, O. DOUBLING DOSE FOR POLYGENIC MUTATIONS IN Drosophila melanogaster. Jap. J. Genet. 36 (1961) 76-83. (In English)

Effects of x-irradiation upon bristle numbers in Drosophila were remarkable for increasing variances but no increase or decrease was observed for the means. This suggests that the chaeta characters in Drosophila are controlled by neutral genes and the cause of variance increase must be due to induced polygenic mutations. The doubling doses for polygenes involving the chaeta characters were estimated by the two different methods, i.e., isogenisation and selection. They are estimated to be 58 r and 29 r respectively for abdominal and sternopleural bristle numbers from the isogenisation experiment and to be 18 r on an average from selection experiments, providing the spontaneous variance increase rates of the traits be 0.005 and 0.001 per generation, respectively. (Auth.)

See also:

471 Effects of irradiation on the Mediterranean meal moth Ephestia kuehniella Zeller, cultured on Sr^{89}-spiked food. (Erdman, 1962)
474 A non-random distribution of lethals induced by tritiated thymidine in Drosophila melanogaster. (Kaplan et al., 1962)
475 The genetic effects of labelled DNA precursors. (Kaplan et al., 1963)
477 Mutagenic effect of C^{14} and H^3 labelled DNA precursors injected into Drosophila melanogaster males. (Strømnaes, 1962)
478 The induction of minute mutations in Drosophila with tritium-labelled thymidine. (Strømnaes and Kvelland, 1963)
479 Cytogenetic studies of x-ray and ingested P^{32} induced sex-linked recessive lethals in Drosophila melanogaster. (Walen, 1962)
758 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1959)
759 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1960).
760 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1961)
770 The induction of mutations in spermatocytes of Drosophila melanogaster with x-rays. (Chandley, 1962)
775 Irradiated parasitic wasps, the effect on progeny production and sex ratio. (DeBach and White, 1963)
793 Sperm transfer, storage, displacement, and utilization in Drosophila melanogaster. (Lefevre and Jonsson, 1962)
800 Induction of mutations and cell killing in irradiated Drosophila spermatogonia. (Oftedal, 1963)
801 Genetic sensitivity and differential killing in irradiated Drosophila spermatogonia. (Oftedal, 1963)
802 Induction of mutations and killing of cells in irradiated spermatogonia of Drosophila. (Oftedal, 1963)
807 Some effects of gamma radiation on the reproductive potential of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962)
814 Studies on the genetic effect of radiation 1959-1960. II. Studies on the genetic effect of radiation with silkworm. (1) Differences between times of death of the F_1 after irradiation of oögonia or mature oöcytes. (Tazima and Onimaru, 1962)
819 R-locus factor homologies in Mormoniella. (Whiting, 1962)
919 Genetic recovery mechanisms and fast neutron treatment of mature sperm treated in males and fertilized females of D. melanogaster. (Alexander, 1961)
923 The rates of translocations and recessive lethals of chromosome IV of Drosophila melanogaster after x-ray treatment. (Belitz, 1963)
926 Radiation analysis of a lecanoid genetic system. (Brown and Nelson-Rees, 1961)
940 Mutation rates at specific autosomal loci in different species of Drosophila. (Hannah-Alava, 1963)
941 Induced changes in female germ cells of Drosophila. VIII. Exchanges induced in different X chromosome regions after x-raying oöcytes and oögonia. (Herskowitz et al., 1962)
944 Spontaneous and radiation mutagenesis and mutability in Drosophila. (Herskowitz, 1963)
969 The brood pattern of x-ray induced crossing-overs in Drosophila melanogaster males. (Puro, 1963)
1000 Mutagenic sensitivity of sperm, spermatids, spermatocytes, and spermatogonia in Drosophila melanogaster. (Chandley and Bateman, 1961)
1005 Patterns of spontaneous and radiation induced mutation rates during spermatogenesis in Drosophila melanogaster. (Ives, 1963)
1006 Radiosensitivity in different stages of spermatogenesis in Drosophila melanogaster. (Kvelland, 1962)
1010 On the nature of sensitivity changes in oöcytes of Drosophila melanogaster. (Parker, 1963)
1014 A comparison of mutation rates in male and female pre- and postmeiotic germ cells of Drosophila. (Ratty, 1961)
1023 Radiosensitivity during spermatogenesis in Drosophila melanogaster. (Strangio, 1962)
1024 Considerations on the changes in observed mutation rates in the silkworm after irradiation of various stages of gametogenesis. (Tazima, 1961)
1029 A comparison of visible mutation rates in Habrobracon eggs x-rayed in first meiotic metaphase or prophase. (Whiting, 1962)
1034 Dependence of the frequency of occurrence of recessive sex-linked lethal mutations in Drosophila spermatogenesis on the fast-neutron dose. (Abeleva and Lapkin, 1963)

1042 Radiation sensitivity in sperm treated in males and inseminated females of Drosophila with x-rays in nitrogen and air. (Alexander and Bergendahl, 1962)
1049 The effects of nitric oxide on radiation damage in Drosophila virilis and Drosophila melanogaster. (Capps, 1961)
1052 Reduction of the sex-linked recessive lethal frequencies in Drosophila melanogaster by argon, nitrogen, and methane under pressure. (Chang, 1960)
1053 Further observations on the relation between gas pressure and the x-ray damage in Drosophila melanogaster. (Chang, 1962)
1054 The effects of chloramphenicol, streptomycin and penicillin on the induction of mutations by x-rays in Drosophila melanogaster. (Clark 1963).
1058 Nitrogen-treatment effects on rearrangement-induction patterns in Drosophila melanogaster. (Falk, 1961/2)
1059 Modification of the radio-induced mutability in Drosophila by 2,4-dinitrophenol. (Fritz-Niggli, 1961)
1060 Preliminary results of combined effects of oxygen and low temperatures on mutations induced by x-rays in Drosophila. (Gavelli et al., 1963)
1063 Effect of fractionating doses on the rate of x-ray-induced mutations in Drosophila. (Guyenot et al., 1961)
1064 Study on the effect of amino-ethylisothiuroniumchloride-hydrochloride (AET) on radiation-induced mutation rate in Drosophila melanogaster. (Henke et al., 1963)
1065 The oxygen effect in irradiated mature and meiotic germ cells of Drosophila melanogaster. (Hoenigsberg et al., 1961)
1066 The effects of developmental temperature on mutational response to gamma rays in Drosophila spermatogenesis. (Ives, 1962)
1076 On a change in the spectrum of somatic mutations in Ephestia kuehniella Z. by temperature treatment before irradiation. (Löbbecke, and Oltmanns, 1961)
1085 Oxygen-effect on mutation-rate induced in different stages of spermiogenesis in Drosophila melanogaster by 31-MeV electrons and 180-kV x-rays.
1087 Differential yields of mutations from the first and second matings after irradiation of mature sperm in Drosophila melanogaster. (Mossige, 1963)
1088 Changes in the mutational spectrum of somatic mutations in Ephestia by pre-treatment with low and high temperatures. (Müller, 1962)
1089 Are chronic and acute gamma irradiation equally mutagenic in Drosophila? (Muller et al., 1963)
1092 Effects of variable dose-rates on radiation damage in the rust-red flour beetle, Tribolium castaneum Herbst. (Nair and Subramanyam, 1963)
1094 Interaction of x-and ultraviolet radiation in production of recessive lethals in Drosophila melanogaster. (Nicoletti and Olivieri, 1962)
1097 The frequency of mosaic mutations induced by gamma rays and neutrons. (Oster et al., 1963)
1098 The mutational spectrum with special reference to the induction of mosaics. (Oster, 1963)
1102 Preliminary report on the effect of cysteine on the rate of x-ray induced mutations in Drosophila melanogaster. (Paik, et al., 1962)
1107 The effect of x-ray treatment combined with air, nitrogen, or oxygen in Drosophila melanogaster studied on sex-linked recessive lethals. (Pozzi et al., 1962)
1108 Differential sensitivity of spermatogenic stages of Drosophila melanogaster to x-ray irradiation in O_2 and N_2. (Pozzi et al., 1962)
1110 Dose-rate and the induction of mutation in Drosophila. (Purdom and McSheehy, 1963)
1111 Radiation intensity and the induction of mutation in Drosophila. (Purdom and McSheehy, 1963)
1115 The genetical response of radiation spermatozoa to different types of radiation treatment. (Reddi, 1963)
1125 Protective action of penicillin against mutagenic effect of x-rays in Drosophila. (Shiomi and Tachibana, 1962)
1126 Effect of penicillin feeding on the reduction of radiation induced mutation rate in Drosophila melanogaster. (Shiomi, 1963)
1136 Repair and differential radiosensitivity in developing germ cells of Drosophila males. (Sobels, 1963)
1141 Modification of genetic radiation damage in Drosophila by post-treatment with nitrogen and fractionation of the dose. (Tates and Sobels, 1961)
1142 Modification of the x-ray induced rate of sex-linked lethals by nitrogen post-treatment and fractionation of the dose in Drosophila melanogaster. (Tates, 1963)
1150 Dose-dependence of radiation-induced mutation rate in Drosophila melanogaster depending on the stage sensitivity of the irradiated germ cells. (Traut, 1962)

1151 A study of dose-dependence of radiation-induced mutation rates in Drosophila melanogaster, allowing for the degree of maturity of the germ cells. (Traut, 1962)

1152 Dose dependence of the frequency of radiation induced recessive sex-linked lethals in Drosophila melanogaster. (Traut, 1963)

1153 Dose-dependence of the frequency of radiation-induced recessive sex-linked lethals in Drosophila melanogaster, with special consideration of the stage sensitivity of the irradiated germ cells. (Traut, 19

1154 The relationship between dosage and mutation rate in x-radiation of Drosophila zygotes. (Ulrich, 1960)

1156 Partial irradiation of Drosophila zygotes by x-rays. (Ulrich, 1963)

1167 The correlation of the ratio of lethal to visible mutations with that of whole-body to fractionals induced by x-rays and chemical mutagens. (Browning and Altenburg, 1961)

1168 Gonadal mosaicism as a factor in determining the ratio of visible to lethal mutations in Drosophila. (Browning and Altenburg, 1961)

1170 Comparative mutagenesis of the dumpy locus in Drosophila melanogaster. II. Mutational mosaicism induced without apparent breakage by a monofunctional alkylating agent. (Carlson and Oster, 1962)

1171 Somatic mutations in the moth Ephestia. (Caspari, 1962)

1175 Mutational response of Habrobracon oöcytes in metaphase and prophase to ethyl methanesulfonate and nitrogen mustard. (Löbbecke and Borstel, 1962)

1179 Rates of forward and reverse mutation in Drosophila after exposure to mustard gas and x-rays. (Sobels, 1962)

1215 Irradiation experiments with Tribolium. (Sokoloff, 1961)

1218 Genetic studies of Drosophila strain differences in sensitivity of the testis to the mutagenic action of x-rays. (Ward et al., 1962)

1231 Prepupal effects of x-ray-induced, euploid and near-euploid mutants in heterozygous condition in Drosophila melanogaster. (Baumiller, 1961)

1232 The effects of x-ray induced euploid and near-euploid mutants in heterozygous condition upon developmental stages of Drosophila melanogaster. (Baumiller, 1962)

1233 Developmental effects of x-ray induced euploid and near-euploid mutants in heterozygous condition in Drosophila melanogaster. I. Delay in egg hatching and larval delay and death prior to pupation. (Baumiller, 1963)

1271 The influence of age and mating patterns before and after irradiation on the incidence of induced mutations in Drosophila melanogaster. (Lefevre, 1963)

1296 X-ray sensitivity of spermatogonia and spermatozoa in Drosophila melanogaster. (Ytterborn, 1962)

1369 Oxygen dependence of the lethal and mutation rates induced by x-irradiation of Drosophila zygotes (Würgler, 1960)

1374 Reactions to x-rays of a normal and a HCN-unsusceptible stock of Drosophila melanogaster. (Lüers, 1963)

1381 A comparative study between natural lethals and lethals induced by radiation in populations of Drosophila willistoni. (Pavan, 1963)

1392 Relative genetic loads due to lethal and detrimental genes in irradiated populations of Drosophila melanogaster. (Chung, 1962)

1397 Persistence of lethals in irradiated natural populations of Drosophila willistoni. (Marques et al., 1963)

1401 Heterozygous effects of induced lethal genes on pre-adult viability in Drosophila melanogaster and their persistence in experimental populations. (Oshima and Kitagawa, 1961)

1404 Mutational recurrence or genetic compensation of lethals in Drosophila natural and irradiated populations? (Reguly and Cordeiro, 1963)

1405 Genetical effects of radiation: a comparative study between natural lethals and lethals induced by radiation in population of Drosophila willistoni. (São Paulo, Brazil, Universidade. Faculdade de Filosofia, Ciencias e Letras, 1963)

1408 Experiments on mutation processes in populations. (Toropanova, 1962)

1411-2 The investigation of the genetic structure of populations. (Wallace, 1961, 1963)

1477 Control of insect populations through genetic manipulations. (LaChance and Knipling, 1962)

I-A-4 CHROMOSOME ABERRATIONS
(BREAKS, CROSSING-OVER, TRANSLOCATIONS, Etc.)

General

917 Abbadessa, R., Burdick, A.B. THE EFFECT OF X-IRRADIATION ON SOMATIC CROSSING OVER IN Drosophila melanogaster. Genetics 48, 10 (1963) 1345-56.

Four different genotypes of D. melanogaster were x-irradiated at 1350 r during the 1st, 2nd, and 3rd larval instars. Treatment with x-rays resulted in a 3-fold increase in the frequency of somatic crossing over, evidenced by incidence of abdominal mosaicism. This effect was influenced by genotype and the ontogenetic time at which irradiation occurred. No mosaic spots were detected in the wings, even after irradiation. It is concluded that if somatic crossing over occurs in the wing anlage, it does so at an extremely low frequency. (Auth. summary)

917-a Evans, H.J. CHROMOSOME ABERRATIONS INDUCED BY IONIZING RADIATIONS. Int. Rev. Cytol. 13 (1962) 221-308.

Detailed review article concerned with a great variety of biological material, and divided into sections dealing with chromosome and chromatid type aberrations; general theory of aberration production; the exchange hypothesis; chromosome stickiness and sub-chromatid aberrations; the relation between aberration structure and the mitotic and meiotic cycles; relative radiosensitivity of different organisms, cell types, and stages in cell development; factors affecting the distribution of aberrations within and between nuclei and chromosomes; the relative efficiencies of different ionizing radiations; the oxygen effect and the importance of oxidative processes in aberration production; and other physical and chemical factors modifying aberration frequencies. Results obtained from studies on insects are also included. More than 500 references are cited.

918 Abrahamson, S. CHROMOSOME REARRANGEMENTS INDUCED BY X-RAYS IN IMMATURE GERM CELLS OF Drosophila. Nature, Lond. 191 (1961) 523-4.

Factors influencing the production of chromosome rearrangements by x-rays in early oöcytes and oögonia of Drosophila melanogaster are investigated, amongst them anoxia, fractionation of treatments, age of females at irradiation, etc. The results are discussed. Data on the frequency of detachments of attached-X chromosomes produced by different modes of treatment are tabulated.

919 Alexander, M.L. GENETIC RECOVERY MECHANISMS AND FAST NEUTRON TREATMENT OF MATURE SPERM TREATED IN MALES AND FERTILIZED FEMALES OF D. melanogaster. (Abstr.) Genetics 46, 8 (1961) 846.

Fast neutrons of an average of 2 MeV energies were utilized to test for increases in sensitivity in mature sperm after female insemination. Mature males and inseminated females were treated with 900 rads of neutrons. Males were mated to Muller-5 females or bw st females and the 1st and 2nd day's tested separately. Sex-linked lethals were scored by the Muller-5 method and translocations tested with bw st. – The results for sex-linked lethals induced in sperm treated in inseminated females were 5.5% (5/90) for the 1st day and 8.3% (51/611) for the 2nd. For treated males, the percentages of lethals were: 1st day 5.4% (40/735) and the 2nd day 3.5% (17/488). – For translocations in the female test, 9.8% (47/479) were obtained for the 1st day and 9.5% (59/623) for the 2nd. For treated males, 5.2% (33/629) were found for the 1st day and 7.8% (43/552) for the second day. By treating males with 1500 rads of neutrons, translocation values of 14.1% (30/212) were observed for the 1st day and 11.8% (22/211) for the 2nd day. Chi-square values were not significant for the 1st and 2nd day comparisons. – The absence of significant or consistent changes in genetic damage in the 2nd day as compared to the first indicates the absence of recovery mechanisms after neutron treatment. Combined values for both days were significantly higher in the female than in the male tests. This increase in genetic damage after sperm insemination shows greater chromosome sensitivity to breakage since recovery mechanisms were not observed and will not explain the increase.

920 Alexander, M.L. DETECTION AND SEPARATION OF SPONTANEOUS AND INDUCED TRANSLOCATIONS IN MATURE AND IMMATURE GERM CELLS OF Drosophila. Amer. Nat. 96 (1962) 309-15.

Translocations of spontaneous origin were detected from unirradiated females in certain strains of D. virilis. Results for the spontaneous translocations were similar in appearance to the expected results if clusters of translocations were recovered from irradiated spermatogonia of males. Additional testing was necessary to separate spontaneous translocations originating in females from induced translocations in males. The method of separation is also applicable to separation of induced translocations of maternal and paternal origin when inseminated females are irradiated. Spontaneous translocations in females involved different chromosomes and therefore offer an evolutionary source of genetic variability of translocations. (NSA 17: 1963, 12138)

921 Bateman, A.J., Chandley, A.C. AN ANALYSIS OF X-RAY INDUCED NON-DISJUNCTION IN Drosophila. (Abstr. 5.41) p.69 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

It is common to distinguish between two forms of meiotic non-disjunction: at first and second division repectively. This is a gross simplification. There are many possible mechanisms resulting in non-disjunction. Some of them are recognisable by their genetic effects. An analysis of matroclinous females in Drosophila, produced by x-rays, has been made in an attempt to determine which modes of non-disjunction are, in fact, operating in their production. Though the results are ambiguous, some definite conclusions can be drawn.

922 Bateman, A.J., Chandley, A.C. THE EFFECTS OF X-RAYS ON CROSSING-OVER IN Drosophila melanogaster. (Abstr.) Heredity 18, 1 (1963) 125.

The effect of x-rays in doses from 1000 to 8000 rads on crossing-over between the X-chromosomes of the female was studied, using the markers sc, ec, cv, ct, v, g, f and car. X-rays produced little or no effect on crossing-over in eggs laid during the first 5 d after treatment but produced a strong depression of crossing-over from day 6 onwards, which was maximal on days 7 and 8. Analysis of the individual segments revealed that the regions most sensitive to this depression were those furthest from the centromere. The segments nearest to the centromere actually showed a significant increase in crossing-over, with a maximum effect at 4000 rads. (From abstr.)

923 Belitz, H.J. THE RATES OF TRANSLOCATIONS AND RECESSIVE LETHALS OF CHROMOSOME IV OF Drosophila melanogaster AFTER X-RAY TREATMENT. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 378.

For the detection of translocations Drosophila males, 1-2 d old, of the stock Berlin-wild were irradiated (100 kV; 1.7 mm Al) and mated each with one homozygous ci ey female. In intervals of 3 d each male was repeatedly mated with a fresh virgin female. In this way 5 broods were won. All ci-animals of the F_1 were tested with a special stock to prove the translocation character. In the broods I-IV (ripe sperms-spermatocytes) the translocation rates increase with dose. They are in a good agreement with dose-effect curves increasing with an exponent of 3/2 dose. The relative values of the rates of all dosages in these broods are: brood I = 1.0; II = 2.6; III = 4.9; IV = 1.0 showing a clear brood pattern. The corresponding values for sex-linked recessive lethals from experiments with the same wild stock under the same conditions for 3 broods are: brood I = 1.0; II = 1.3; III = 1.1. For the recessive lethals of chromosome IV we have found at 3.0 kr: brood I: 3/917 = 0.33%; II: 8/713 = 1.12%; III: 1/317 = 0.32%. In both cases the maximum for recessive lethals lies in brood II. So the results show different brood patterns for translocations and recessive lethals, respectively. In brood V (late spermatogonia during irradiation) in the translocation experiments the experimental findings are: 1.5 kr: 5/8571 = 0.11%; 3.0 kr: 7/7780 = 0.09%; 4.5 kr: 3/6425 = 0.05%; 6.0 kr: 4/4982 = 0.08%. It is not possible to construct a dose-effect curve of the type mentioned above which is in agreement with these values. It seems reasonable to construct a dose-effect curve going through the point for 1.5 kr. Then the low mutation rates at higher doses may be explained by germinal selection, i.e. all chromosome fragments which have not undergone a recombination or restitution before the next division are eliminated. Subtraction of the experimentally determined mutation rate from the estimated curve gives a curve for the action of germinal selection running parallel to the theoretical dose effect curve in the investigated dose range. First results concerning recessive lethals of chromosome IV in this brood show an increase of this type of mutations in late spermatogonia (3.0 kr: 2/824 = 0.24%; 4.5 kr: 1/225 = 0.44%) indicating that recessive lethals are not affected by this kind of germinal selection. (From abstr.)

924 Brosseau, G.E., Jr., Nicoletti, B., Grell, E.H., Lindsley, D.L. PRODUCTION OF ALTERED Y CHROMOSOMES BEARING SPECIFIC SECTIONS OF THE X CHROMOSOME IN Drosophila. Genetics 46, 3 (1961) 339-46.

A method for producing marked Y chromosomes by irradiating reciprocal translocations between an XY chromosome and some other element in the genome has been used and a series of marked Y's recovered.

The most useful markers that have been appended to a Y are B^S, w^+ and N^+, and ma-1^+. In addition to these Y's, which carry single marker segments, a number of doubly marked Y's have been constructed. The current best estimate of the constitutions of the known marked Y chromosomes are tabulated. (Auth. summary)

925 Brosseau, G.E., Jr. NON RANDOM RECOVERY OF DETACHMENTS FROM AN ATTACHED-X CHROMOSOME IN Drosophila. (Abstr.) Genetics 46, 8 (1961) 854.

Irradiation of females of the constitution y^2 su-w^a w^abb : = /B^SY y^+ with 990 r of x-rays yielded 159 detachments. Of these 57 carried B^S, 58 were y^+, 32 carried neither marker and 12 were sterile or were lost before testing was completed. The detachments that carried neither marker were tested further for evidence of involvement of the Y in the exchange and none was found. These are probably autosomal detachments and were not tested further. The remainder of the detachments were tested to determine the location of the Y break with respect to bb^+ and the fertility factors. Complementary detachments were recovered in very unequal numbers. The exchange resulting in a detachment produces an asymmetric dyad from which the shortest element is recovered more frequently. This is similar to those cases in which Novitski (1951) found non random disjunction, and it is likely that this is another case of the same phenomenon. The coefficients of non randomness for 3 classes of detachments are: 0.76, 0.88, 0.71. Fifty-three of the 115 breaks or 46.1% were between the most distal fertility factor of the arm involved and the X-derived terminal marker. Another peak of breakage occurs in the portion of Y^S that is homologous to the X. Perhaps most of the exchanges that produce detachments occur in synapsed homologous regions and detachments with the Y might be induced crossovers rather than translocations.

926 Brown, S.W., Nelson-Rees, W.A. RADIATION ANALYSIS OF A LECANOID GENETIC SYSTEM. Genetics 46, 8 (1961) 983-1007.

In the lecanoid chromosomal system, as exemplified by the mealy bug, Planococcus citri (Risso), one chromosome set becomes heterochromatic during embryogeny of the male and is maintained as such during development. At spermatogenesis, the first division is equational for both the euchromatic and heterochromatic chromosomes which are segregated from each other in the second; only the euchromatic derivatives form sperm. Schrader and Hughes-Schrader suggested that the heterochromatic set is genetically inert and Hughes-Schrader suggested that it is of paternal origin. Radiation studies were undertaken to test the Schraders' hypotheses. After paternal irradiation, the induced aberrations appear in the heterochromatic set of the male embryos while they occur in the euchromatic set after maternal treatment. Hughes-Schrader's hypothesis of the paternal origin of the heterochromatic set is therefore confirmed. After maternal treatment, both sexes diminish with increasing dosage but the results are complicated by the effect of maternal age on the sequence in which the two sexes of offspring occur during oviposition (sexual dichronism) as well as on total progeny. (From auth. summary).

927 Chandley, A.C., Bateman, A.J. DOSE-DEPENDENCE OF X-RAY INDUCED NON-DISJUNCTION IN Drosophila melanogaster FEMALES. (Abstr. 5.42) p.69 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

The frequency of induced non-disjunction in female germ cells has been estimated on eleven successive days following irradiation with x-rays. Doses of 1, 4, 6 and 8 k rad have been used and the results indicate a non-linear dose-dependence both for female (XXY) and male (XO) exceptions. Over the first 6 d, the frequency appears to increase with the square of the dose. In spite of the frequency of male exceptions being 4-5 times as great as that of the female exceptions, the shapes of the dose-dependence curves are closely similar. After day 6, when the female and male exceptions have equal incidences, the dose-dependence departs even further from linearity.

928 Chandra, H.S. CYTOGENETIC STUDIES FOLLOWING HIGH DOSAGE PATERNAL IRRADIATION IN THE MEALY BUG, Planococcus citri (Risso). Thesis. California, Univ., Berkeley, 1962.

929 Chandra, H.S. CYTOGENETIC STUDIES FOLLOWING HIGH DOSAGE PATERNAL IRRADIATION IN THE MEALY BUG, Planococcus citri. I. CYTOLOGY OF X_1 EMBRYOS. Chromosoma 14 (1963) 310-29.

In the mealy bug, Planococcus citri, following high dosage paternal irradiation (60 000 to 120 000 rep), the survivors are mostly female (about 30 to 40% of the unirradiated control value) whereas very few males survive (about 5% of control value). After lower doses of paternal irradiation (P.I.), however, few or no females survive while the normal number of males (never less than the control value) survive.

The females developing after high dosage P.I. are gynogenetic and are triploid or diploid or 3N/2N or 2N/N mosaics. The cytology of X_1 embryos following 90 000 rep is described in comparison with data from embryos following lower doses (8000 r) of P.I. and unirradiated controls, to illustrate the chromosomal mechanisms leading to the production of gynogenetic females and the probable reasons for lethality of X_1 males after heavy P.I. It has been shown that triploid females stem from a fusion nucleus of the first and second polar bodies. This triploid polar nucleus, which normally participates in the formation of a polyploid sector in the young embryo, undertakes a successful embryogeny in many embryos when the zygote nucleus is unable to do so because of the heavily damaged paternal complement of chromosomes. Since the chromosomes are characterized by holokinetic activity, the irradiated paternal set manages to divide with the maternal complement but did not always segregate as successfully. Restitution divisions of the zygotic nuclei result in haploid, hyperhaploid, diploid and polyploid nuclei. Most of the diploid gynogenetic females probably originate from diploid nuclei of zygotic origin although it is possible that a few diploid females and the 2N/N mosaic females develop from polar bodies. (Auth.)

930 Chandra, H.S. CYTOGENETIC STUDIES FOLLOWING HIGH DOSAGE PATERNAL IRRADIATION IN THE MEALY BUG, Planococcus citri. II. CYTOLOGY OF X_1 FEMALES AND THE PROBLEM OF LECANOID SEX DETERMINATION. Chromosoma 14 (1963) 330-46.

When females of the mealy bug, Planococcus citri, are mated to males previously irradiated with heavy doses of γ-rays (30 000 to 120 000 rep), the progeny is mostly female. These X_1 females are gynogenetic, with unbroken chromosomes. Detailed cytology of 17 such gynogenetic females showed triploids, diploids, and 3N/2N and 2N/N mosaics. Most of the embryos produced by triploid mothers were aneuploid and these degenerated before gastrulation. Regardless of aneuploidy, male embryos showed the typical lecanoid heterochromatization of the paternal set of chromosomes. Just prior to degeneration, the euchromatic chromosomes in the aneuploid male embryos showed endomitotic splitting while the heterochromatic did not. Among the progeny of 3N♀×2N ♂ matings, only males with 5 euchromatic +5 heterochromatic chromosomes and females with 10 or 15 euchromatic chromosomes were found. A search for adults with 5 heterochromatic + 10 euchromatic chromosomes among the progeny of triploid mothers was unsuccessful. Chromosomal variables such as aneuploidy of the euchromatic set, haploidy and fragmentation are discussed in relation to the problems of heterochromatization of the paternal set and sex determination in this species. (Auth.)

931 Chovnick, A., Schalet, A., Kernaghan, R.P. RECOMBINATION AT THE ROSY LOCUS IN Drosophila melanogaster. (Abstr.) Genetics 46, 8 (1961) 858-9.

A series of spontaneous and x-ray-induced mutants at the rosy locus (3-52.4) were subjected to recombinational analysis through the use of a crossover-selector system (Whittinghill 1950). Males from a balanced stock, In(3) MRS, M34 ry^2 Sb/Dfd ry^2 Ubx e^4, were mated to two series of females: (A) M34 Dfd ry^x + + / + + ry^y Sb Ubx and (B) M34 dfd ry^y ++/ ++ ry^x Sb Ubx. Due to homozygous lethality associated with the markers M34, Dfd, Sb, and Ubx, all offspring of these crosses die except 1/4 of the crossovers between M34 and Dfd, 1/4 of the crossovers between Sb and Ubx, and 1/2 of the crossovers between Dfd and Sb. Viable offspring represent only 5% of all zygotes. The remaining 95% die as larvae or pupae. From a set of such crosses most adult offspring are phenotypically rosy. The sporadic ry^+ individuals consistently found in one of the two crosses in a set invariably carry appropriate markers indicating their origin as crossovers between separable sites within a complex locus. The double mutant types, expexted in the cross that does not yield ry^+ individuals, have not been distinguished. Three separable sites within the rosy locus have been established: (ry^1, ry^4, ry^8, ry^9) - ry^{26} - (ry^2, ry^6, ry^7). Significant failure of recombination has not been observed. Map distances, estimated as 2×(# of ry^+ recombinants) ×100/200×(total surviving offspring), range from a high of 0.005 to a low of 0.0004. An improved selective system with increased percent killing and some egg mortality has replaced the above system in current experiments. – All mutants reported here are noncomplementary for eye colour and xanthine dehydrogenase activity. Current data support the existence of a single complementation group.

932 Crow, J.F., Thomas, C., Sandler, L. EVIDENCE THAT SEGREGATION-DISTORTION PHENOMENON IN Drosophila INVOLVES CHROMOSOME BREAKAGE. Proc. nat. Acad. Sci., U.S. 48 (1962) 1307-14.

When distorting males in the segregation-distorter (SD) strains of Drosophila were x-irradiated, they produced a larger fraction of chromosomes showing recombination about the SD region than controls. The SD effect on the homologue was concluded to be a chromosome break because of the ability to rejoin with a radiation-induced break. (A 57 : 1962, 17230 f).

933 Dubinin, N.P., Kanavets, O.L. FACTORS OF COSMIC FLIGHT AND PRIMARY NON-DISJUNCTION OF CHROMOSOMES. p.350-8 in FTD-MT-62-78, n.d. Translation.

The genetic consequences of non-disjunction of chromosomes are reviewed. Data are presented from an analysis of non-disjunction of sex chromosomes in female Drosophila subjected to space flight. Results are compared with data on female Drosophila exposed to x-radiation or to the conditions encountered during space flight with the exception of radiation exposure. Space flight caused more primary non-disjunctions, and the genetic effects were evident for longer periods of time than either of the other conditions tested. (NSA 17: 1963, 35283)

934 Fabergé, A.C., Judd, B.H. CHROMOSOME BREAKS BY ALPHA PARTICLES. Drosophila Inf. Serv. 35 (1961) 79-80.

935 Frye, S.H. CONCERNING THE X-RAY DOSE-FREQUENCY RELATION FOR MINUTE CHROMOSOME CHANGES IN THE YELLOW REGION IN Drosophila melanogaster. (Abstr.) Genetics 47, 8 (1962) 953.

Totals of yellow mutants, x-ray-induced in y^+ scute-8 chromosomes of mature and nearly mature sperm ejaculated 0-2 and 2-4 d after irradiation), were found to exhibit approximately a linear dose-frequency relation. The presence or absence (inactivation) of markers closely linked to yellow was determined by genetic analyses of 98% of the 558 yellows that were able to breed and were transmitted. Intergenic or "breakage" yellows accounted for 96-98% of the transmissible yellows and these were roughly classified into "only minute" and "gross" chromosome changes. – The induced frequencies of "only minutes" varied significantly below linearity with dose, whereas those of "gross changes" varied significantly above linearity. Hence, the linear dose-frequency relation of total yellow mutants is complex and consists of at least three presumptive components: sublinear, linear, and supralinear. Dose frequencies of the "only minutes" did not disagree significantly with that expected were they proportional to the 0.8 dose power. However, dose frequencies of total minutes accorded satisfactorily with the theoretical expectation of linearity if the total minutes included those gross yellows "capped" by a translocated autosomal end piece and other simultaneous gross and minute yellow changes lost by aneucentricity. Availability of a more accurate criterion of minute versus gross than the determination of which side of bb^+ the right-hand break lay on would have yielded more homogeneous classes and sharper dose-frequency relations. The dose-frequency criterion is more likely to be meaningful where heterogeneities, such as germ cell treated, structure of the mutants, and others are minimal.

936 Frye, S.H. A STUDY OF MINUTE STRUCTURAL CHANGES OF CHROMOSOMES IN Drosophila. Diss. Abstr. 24, 1 (1963) 443-4.

The problem of minute chromosome change was reinvestigated by studying the frequency-dose relation of changes of the yellow locus in scute-8 chromosomes of mature and nearly mature sperm (ejaculated from 0-2 and 2-4 d after irradiation) in relation to 4 x-ray doses. The frequencies at which 607 exceptional yellow females occurred in relation to x-ray dose can be represented by a linear equation. Genetic analysis in order to determine the presence or "absence" (inactivation) of markers closely linked to the yellow locus were conducted on 98% of all yellows able to breed and be transmitted. After analysis and subjection to various structural and/or phenotypic criteria, the yellows were classified into 2 categories. Extragenic or breakage yellows accounted for 96-98%; presumptive intragenic or non-breakage yellows for 4-2%. It was deduced from the frequency-dose curves that many of the two breaks, produced close together, were produced in the course of a single ionizing particle, whereas many of the two (or more) breaks, produced far apart, in the course of 2 separate ionizing particles. Two serious sources of heterogeneity are discussed: changes of sensitivity within short periods during spermatogenesis, and structural heterogeneity of the most common groups classified as "minute" changes. The linear relation found between yellow mutants of all classes taken together and x-ray dose is complex in its details. This complexity is discussed further.

937 Goldschmidt, E., Barak, E., Bernstein, N., Falk, R. THE RESTITUTION OF RADIATION INDUCED BREAKS IN STRUCTURAL HETEROZYGOTES OF Drosophila. (Abstr. 5.49) p.72 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Males of D. melanogaster carrying the Cy (II L) inversion and their structurally homozygous brothers were given an x-ray dose of 5000 r. The salivary glands were scanned in larval offspring of both groups of males, and all breaks induced in euchromatic sections of the entire chromosome set were located. The rate of induced aberrations was higher in the F_1 produced by Cy fathers. The hatchability of eggs fertilized by irradiated males of both groups was studied in order to compare the brood patterns and the overall rates of "dominant lethals" induced during the premeiotic stages up to the first meiotic anaphase. It has been suggested that the loop configuration in the heterozygous bivalent facilitates non-homologous contact and thus promotes abnormal restitution. A more comprehensive hypothesis proposes that each of two perfectly synapsed homologues provides a "splint" for the normal restitution of its partner. Hence asynapsis *per se* will interfere with the normal repair of breaks. On this assumption the structural heterozygosity of *one* bivalent, promoting asynapsis in non-homologous elements, may be responsible for the increased production of abnormal restitutions in the entire chromosome set.

938 Gottlieb, F.J., THE CONTROL OF BRISTLE PATTERN BY HAIRY-WING IN *Drosophila melanogaster*. *Diss. Abstr.* *24*, 3 (1963) 941.

An analysis of the control of developmental patterns exercised by the mutant gene Hairy-wing 49c was undertaken. This gene, in addition to causing the formation of chaetae on the wing veins, controls the formation of extra macro-and microchaetae on the thorax. In homozygous condition it causes the thorax to be disproportionately wider at the level of the dorsocentral region and controls the formation of numerous extra microchaetae in the dorsocentral region. The number of rows of achrostichal chaetae is greatly increased and numerous extra macrochaetae are present. The heterozygote does not show this disproportionate increase in width and, while it has an increase in the number of achrostichal rows, does not show any significant increase in microchaete density in the dorsocentral region, and possesses fewer extra macrochaetae than the homozygote. By means of genetic mosaics, produced by inducing somatic crossing-over in heterozygous larvae with x-irradiation, a developmental analysis of the differences in differentiation in the tissues of the Hairy-wing homozygous genotypes were performed. X-irradiation causes Hairy-wing heterozygotes to express themselves in a homozygouslike fashion.

939 Grell, E.H. THE DOSE EFFECT OF *ma-l*$^+$ and *ry*$^+$ ON XANTHINE DEHYDROGENASE ACTIVITY IN *Drosophila melanogaster*. *Z. VererbLehre* *93* (1962) 371-7 .

Two loci, *ma-l*$^+$ and *ry*$^+$, necessary for xanthine dehydrogenase activity were studied for dosage effects utilizing deficiencies and duplications induced for this purpose. Rather than assume that the known *ma-l* and *ry* mutations are deficient for all gene activity, true chromosomal deficiencies were produced by x-irradiation. Comparisons of 1, 2 and 3 doses of *ma-l*$^+$ in the female or 1 and 2 doses in the male indicate that there is no increase in specific enzyme activity with dose. On the other hand, comparisons of 1, 2 and 3 doses of *ry*$^+$ in the male and female reveal an increase in enzyme activity that is roughly proportional to dose. Since dosage of *ry*$^+$ is limiting, whereas that of *ma-l*$^+$ is not, the final concentration of xanthine dehydrogenase is shown to depend on the number of doses of *ry*$^+$. The implications of these findings with respect to the hypothesis of dosage compensation and to the mechanism of control of enzyme and protein concentration are discussed.

940 Hannah-Alava, A. MUTATION RATES AT SPECIFIC AUTOSOMAL LOCI IN DIFFERENT SPECIES OF *Drosophila*. Six-months report, due April 30, 1963. TID-18979, Turku, Finland. Univ. 9p.

Preliminary results of genetic studies on *D. melanogaster* are presented. Analysis of data on 46 males mated singly, sequentially, and daily after the 7th day, or until the male died, for 24 d after treatment with 3000 r x-radiation, indicated that induced crossovers occurred in one brood as pseudoclusters, and that clusters beginning the 12th or 13th day after irradiation and initial mating may continue for a number of broods. (NSA 17 : 1963, 28599)

941 Herskowitz, I.H., Schalet, A., Reuter, M.D.V. INDUCED CHANGES IN FEMALE GERM CELLS OF *Drosophila*. VIII. EXCHANGES INDUCED IN DIFFERENT X CHROMOSOME REGIONS AFTER X-RAYING OÖCYTES AND OÖGONIA. *Genetics* *47* (1962) 1663-78.

Following exposure of germ cells of female *D. melanogaster* either to 3000 to 4000 r or to no dose of x-rays, induced exchanges involving proximal or distal regions of the X chromosome were detected in F$_1$. The results support the view that x-ray-induced recessive lethal mutants in oöcytes typically arise as the result of events which involve only a single strand of a tetrad.

942 Herskowitz, I.H., Norton, I.L. ARRANGEMENT OF CHROMOSOMES IN MATURE SPERM. (1) *Drosophila Inform. Serv.* *37* (1963) 88-9.

Recessive lethals from 18 MeV electrons are distributed among the sperm of different males according to Poisson expectation, even though some lethals are due to position effects following chromosomal rearrangement. It is pointed out that the usual recessive lethal studies are not likely to furnish readily critical evidence on the positioning of sperm chromosomes. A study of II-III reciprocal translocations was performed, using 1500 r x-rays. Sperm samples from different single ejaculates were examined. Subject to the correctness of the authors' premise restricting the joining of ends produced by x-ray breakages to those located closely, the results do not indicate that the chromosomes in the different sperm are arranged in an other-than-random fashion.

943 Herskowitz, I.H., Lacy, Mother Stanislaus, Baumiller, R.C. ARRANGEMENT OF CHROMOSOMES IN MATURE SPERM. (2) *Drosophila Inform. Serv.* *37* (1963) 89.

Assuming (1) that proximity of broken ends derived from x-ray tracks of ionization favours cross-union, and (2) that a bias which occurs in orientation of chromosomes at meiosis also results in an orientation bias in the mature sperm, only males were utilized whose sperm chromosomes were all similarly biased in orientation at meiosis, and males whose sperm chromosomes are not biased in such a way. The results indicate, however, that the arrangement of overlapping chromosomes in the sperm head is not appreciably influenced by any orientation which chromosomes may have had during meiosis.

944 Herskowitz, I.H. SPONTANEOUS AND RADIATION MUTAGENESIS AND MUTABILITY IN *Drosophila*. (Abstr. B1F206) p.50 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

The broad purpose of the proposed programme is to learn more about the phenotypic effects of mutations and the factors involved in the production of chromosomal breakage, chromosomal rearrangement, and point mutation occurring spontaneously and induced by radiations in a given cell type, including different stages in its differentiation, and in several cell types. Attempts will be made to construct stocks containing balanced lethals which when mated together result in the death of all progeny during the egg stage, unless non-disjunction or reverse mutation occurs. If such stocks can be constructed, they will be used to study spontaneous and x-ray-induced non-disjunction and reverse mutation of recessive lethals. Various mutational events will be studied, following x-ray or no x-ray treatment of developing eggs, when the adenine available is or is not restricted in the diet of larvae auxotrophic for adenine. Using a diet restricted in adenine, the effects of adding other purines or adenosine to the diet will be studied upon the spontaneous and/or x-ray-induced mutation rate. Several experiments are planned to study the effect of penicillin on x-ray-induced mutations of various kinds.

945 Hughes-Schrader, S., Schrader, F. THE KINETOCHORE OF THE HEMIPTERA. *Chromosoma* *12* (1961) 327-50.

To induce chromosome breakage, adult males and nymphs of *Euschistus servus*, *E. tristigmus*, and *Solubea pugnax* were irradiated with 100 to 750 r doses of x-rays. The diffuse nature of the kinetochore was demonstrated by the ability of chromosome fragments to perpetuate themselves mitotically through many cell generations of spermatogonia. Free fragments, when not immobilized by the effects of radiation, are also capable of meiotic mitosis. A holokinetic, rather than a telomeric, nature was thus demonstrated for the meiotic restriction of kinetochore activity to chromosome ends, normal for Heteroptera and certain other Hemiptera. Simple fragmentation as a factor in the evolution of compound sex chromosomes was supported by the observation that fragments of the X chromosome co-orient with the Y in a typical touch-and-go pairing. (NSA 16 : 1962, 10404)

946 Ives, P.T., Fink, G.R. COMPARISON OF TRANSLOCATION AND CROSSOVER CHROMOSOMES PRODUCED BY γ-IRRADIATION OF *Drosophila* MALES. (Abstr. Genetics *47*., 8 (1962) 963.

Translocations (Ts) of chromosomes 2 and 3 were derived from days 5 and 6 sperm of Oregon-R/rucuca males and crossovers from days 9 and 10 sperm, using an exhaustive mating schedule at 25°C after two kr. Tests showed homozygous lethality in 84 of 102 Ts and in 24 of 105 non-T second chromosomes also derived from days 5 and 6 sperm. The estimated lethality due to a T is 0.35 of a lethal for each of its two chromosomes, with 2.7 T lethals to one non-T lethal per chromosome. In contrast 11 of 141 crossover chromosomes appearing in males and ten of 172 non-crossover sibling third chromosomes from days 9 and 10 sperm were recessive lethals, the difference in these two frequencies being nonsignificant (P=0.6). The lower lethality in crossovers *versus* Ts and the absence of a comparable increase in proportion of lethals in crossover chromosomes support the views that induced crossovers and Ts are genetically different at their exchange sites (Patterson and Stone 1934) and that if both result from induced chromosome breakage then lethality arises not from this breakage but probably from a position effect of genes not themselves affected by the irradiation. (Earlier comparable studies were rendered uncritical by the later discovery of widely divergent induced mutation frequencies at different spermatogenic stages.) A difference between induced male and normal female crossingover is still apparent in their very different propotionate chromosomal distributions.

947 Kunze-Muehl, E. UNTERSUCHUNGEN ÜBER DIE VERTEILUNG DER BRUCHSTELLEN NATÜRLICHER UND STRAHLENINDUZIERTER CHROMOSOMENDISLOKATIONEN BEI Drosophila subobscura COLL. (Studies on the distribution of breakage sites of natural and radiation-induced chromosome dislocations in Drosophila subobscura Coll.) Chromosoma 12 (1961) 286-309. (In German)

Cytologic analysis of radio-induced dislocations was studied in salivary gland chromosomes of the F_1 larvae produced by mating irradiated male flies with normal females. The males, 10-d-old individuals of the Küsnacht strain, were irradiated with 5000 r. Examination of the salivary glands of 646 F_1 larvae revealed a total of 74 translocations and 30 inversions in 92 larvae. On the basis of previous studies, dislocations corresponded to 234 breakage points. The percentage of dislocations in the sperm (14.24 ± 1.37%) was lower than that obtained in previous experiments on other Drosophila species, at the same radiation dose. The distribution of the 234 radio-induced and 152 natural breakages was considered on a statistical basis, and the results discussed critically. On the basis of small chromosome segments, 3 autosomes were found to show a significant deviation from random distribution.

948 Leigh, B. THE INDUCTION OF XO MALES, BY IRRADIATION OF Drosophila melanogaster MALES. (Abstr. 5.39) p.68-9 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

It has been found that, after the irradiation of adult males, there is a difference in the sperm samples which show the highest frequencies of lethals and translocations, and those which show the highest frequency of XO males. A set of experiments were carried out to investigate this discrepancy. Twenty-four-hour old males, of the genetic constitution $X^{C2}yB$; sc^8 Y, were treated with doses from 0-3000 r. A brood pattern of five 2-d broods was used, with 6 females per male per brood. The F_1 was scored for XO males, non-disjunction females, and sex ratio. The highest frequency of XO males was found in sperm sampled on the 7-8th days after irradiation, presumably corresponding to young spermatocytes, and this was not accompanied by any comparable increase in the number of non-disjunction females. From the structure of the ring-X it is expected that most breaks will result in loss of the chromosome. This is supported by the fact that the same dose of irradiation produces more XO males from the ring-X than from a rod-X. The dose effect curve for the production of XO males is a straight line, one-hit event. A comparison of this dose effect curve with that of the change in sex ratio gives further evidence that XO males are mainly produced by loss of the X chromosome. A hypothesis to explain the different peaks for the 2 types of breakage-involving effects, XO males and translocations, is discussed.

949 Lindsley, D.L. GENERAL SURVEY OF GENETIC EFFECTS OF CHROMOSOMAL ABERRATIONS. p.273-89 in "Report of a Conference on Radiation-induced Chromosome Aberrations held in San Juan, Puerto Rico, 16-18 November 1961". Wolff, S., Ed. New York, Columbia University Press. 1963.

Genetic effects of radiation on mature Drosophila sperm are discussed. It is concluded that single breaks that occur too far from another break to interact with it, if they occur, do not remain open, do not form dominant lethals, and thus by a process of elimination must restitute. When there are two broken strands within a site, three types of intrabrachial rearrangement are possible: (1) they may reunite to form a chromosome unchanged except for mutational scars, (2) they can rejoin to produce an acentric ring and a rod deficient for the region included in the ring, or (3) they may rejoin to form an inversion. Interbrachial rearrangements and the situation where, within a site, there are two different arms are also considered. Two such breaks may restitute, they may rejoin to produce a dicentric and an acentric, or they may form reciprocal translocations. Translocations between the X chromosome and the autosomes are used to illustrate how the genetic effects of aberrations may affect the validity of scoring procedures. (NSA 17:1963, 25016)

950 Lüning, K.G. CAN Drosophila SPERMATOZOA BE USED IN STUDIES OF RECOVERY PROCESSES? J. cell. comp. Physiol. Suppl. 1 58 (1961) 197-201. Symposium on "Recovery of Cells from Injury" Gatlinburg, Tennessee, 3-6 April 1961.

Data are presented on the x-irradiation of sperm in pure O_2, air, or in nitrogen mustard, followed by mating within the first 24 h. Data on the effects of dose fractionation on the induction of point mutations and chromosome breaks are also included. The results cannot be interpreted as proving the occurrence of a recovery process in sperm irradiated in a stage supposedly rather well supplied with oxygen. The need for dealing with well-defined cell stages is heavily stressed by the author, in view of the otherwise inevitable heterogeneity in results.

951 McCarthy, J.C., Nafei, H. A TEST FOR X-RAY INDUCED TRANSLOCATIONS IN SPERMATOGONIA OF Drosophila melanogaster. Genet. Res. 4 (1963) 485-6.

The frequency of genetically detectable translocations was determined in spermatozoa, spermatocytes, and early and late spermatogonia in irradiated male D. melanogaster. The males were exposed to 3000 r of x-radiation and mated to 3 types of tester females. Results are presented in tabular form. (NSA 18: 1964, 8156)

952* Mainx, F. STRAHLENINDUZIERTE UND NATÜRLICHE CHROMOSOMENDISLOKATIONEN BEI Drosophila subobscura. (Radiation-induced and natural chromosome dislocations in Drosophila subobscura.) p.567-73 in "5^a Rassegna Internazionale Eletronica e Nucleare. Atti del Congresso Scientifico. Sezione Nucleare. 16-20 Giugno 1958. Vol.I". Rome, Palazzo dei Congressi-E.U.R. (In German)

A preliminary report on investigations of radiation-induced and natural chromosome dislocations in Drosophila subobscura is presented. A localization of 152 breaks of the natural inversions shows that the distribution of the broken places over the chromosomes does not follow a probability distribution. The inversions and translocations caused by x-radiation show the same distribution.

953 Mainx, F., Doschek, E. CROSSING-OVER IN IRRADIATED FEMALES AND MALES OF Megaselia (PHORIDAE). (Abstr. 7.29) p.127 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Megaselia scalaris has become an interesting object for genetic studies in many respects. A new type of sex determination was discovered in this fly and reported on recently. Crossing-over occurs also in males. The crossing-over values are considerably reduced in males. The differing rates of this reduction depend on the localization of a given zone in the chromosome. Crossing-over values increase after irradiation of the pupae to a certain extent. This increase again differs for particular chromosomal zones in female and in male. Established on these results a new theory of crossing-over could be considered.

954 Manna, G.K., Mazumder, S. THE GRASSHOPPER X-CHROMOSOME AS AN INDICATOR FOR X-RAY INDUCED CHROMOSOME BREAKAGE. Proc. Calcutta Zool. Soc. 15, 2 (1962) 103-10.

X-ray induced X-chromosome breakage at the diplotene stage in the grasshopper, Gesonula punctifrons has been studied. The breakages of the X-chromosomes have been classified as "chromatid", "chromosome" and "mixed" type breakages and their frequency distributions have been recorded at 80 r 160 r, and at 240 r of x-rays. The frequency of breaks is directly proportional to the dosage used. The radiation breaks of the X-chromosomes are not at random, and regional localizations of the breaks have been observed not only in G. punctifrons but also in 2 other species of different genera. A difference in the frequency of breakages at a given dose among the different species has also been observed. Our data show that the frequency of radiation induced X-chromosome breakages is much higher than that of the autosomes. (Auth.)

955* Nakanishi, Y.H. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION AND CHEMICALS ON THE CELL AND THE CHROMOSOMES. I. TYPES OF X-RAY-INDUCED CHROMOSOME ABNORMALITIES IN GRASSHOPPER SPERMATOCYTES, WITH A NOTE ON THE NORMAL COURSE OF THE FIRST DIVISION AS CONTROL. J. Fac. Sci. Hokkaido Univ., Ser. VI. Zool. 14 (1958) 83-91.

956* Nakanishi, Y.H., Makino, S. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION AND CHEMICALS ON THE CELL AND THE CHROMOSOMES. II. FORMATION OF ANUCLEAR BUDS, CONTINUATION OF CHROMOSOME STICKINESS AND FORMATION OF AN ACCESSORY NUCLEUS IN GRASSHOPPER SPERMATOCYTES FOLLOWING X-IRRADIATION. Tex. Rep. Biol. Med. 18 (1960) 66-74.

957 Nelson, D.J., Blaylock, B.G. THE PRELIMINARY INVESTIGATION OF SALIVARY GLAND CHROMOSOMES OF Chironomus tentans FABR. FROM THE CLINCH RIVER. p.367-72 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.

Some of the Chironomus tentans Fabr. larvae collected from White Oak Creek and the Clinch River have unusual forked preanal gills. A subsequent cytogenetic study showed the salivary gland chromosomes of the C. tentans propulation contain what appears to be a relatively high frequency of chromosomal aberrations. 23 individuals in a sample of about 300 were found which had 3 chromosomes each instead of the usual 4. These populations from areas contaminated with radioactive waste effluents have not been compared with other local populations not exposed to these effluents. The radiation from radionuclides sorbed on the river and creek bottom sediments is 20 to 1000 times that of natural background. The larvae are also exposed to a heterogeneous mixture of chemicals in the effluent released to the environment. The mutagenic effect of chemicals is erratic when compared with the effect of ionizing radiation. (Auth. summary).

958 Nelson-Rees, W.A. THE EFFECTS OF RADIATION DAMAGED HETEROCHROMATIC CHROMOSOMES ON MALE FERTILITY IN THE MEALY BUG, *Planococcus citri* (Rossi). *Genetics* *47*, 6 (1962) 661-83.

The chromosomes contributed by the father to the zygote of male mealy bugs become heterochromatic at late blastula. This complement does not itself form gametes. However, the present results indicate a decided influence of this set on fertility of the male and can no longer be considered genetically inert. Following high dosage γ-irradiation of fathers, a certain bulk of heterochromatin (based on linear measurements of the holokinetic entities), no matter how deranged, must be present for the survival of the sons, and a presumably less affected set must be present for the sons to be fertile to any extent. With increase in dosage there is a quantitative reduction of fertility of the sons based on the production of fewer normal functioning sperms. This is due to a gradual onset of derangements in spermiogenesis at all doses, but an increased total effect with increase in dosage. (Auth.)

959 Novitski, E. CHROMOSOME BREAKAGE IN INVERSION HETEROZYGOTES. *Amer. Nat.* *95*, 883 (1961) 250-1.

Note follows up some opinions expressed by the author and taken up by Bernstein and Goldschmidt (*ibid* 53). After some comments, Novitski describes an experiment in which *Drosophila melanogaster* females, heterozygous for the inversion roughest (Genetics 31: 1946, 508), were x-rayed with 1800 r. Male progeny were examined for loss of the position effect. Of some 32 000 progeny checked, 6 cases of reversion were found which appeared, after extensive investigation, to be precise reinversions, genetically indistinguishable from a normal chromosome.

960 Novitski, E. THE REGULAR REINVERSION OF THE ROUGHEST^{3} INVERSION. Genetics *46* (1961) 711-7.

Females heterozygous for the roughest inversion were x-rayed, and their progeny examined for reversions of the phenotype. Six were found which, by both genetic tests and cytological examination, appeared to be precise reinversions of the roughest^{3} inversion. It is suggested that the inversion loop formed in the heterozygote facilitates breakage and reunion in the vicinity of the break points of the original inversion. (Auth. summary)

961 Novitski, E., Hanks, G.D. ANALYSIS OF IRRADIATED *Drosophila* POPULATIONS FOR MEIOTIC DRIVE. *Nature,* Lond. *190* (1961) 989-90.

Irradiated populations of *Drosophila* were analysed for the existence of chromosomes or alleles represented in the gametes of a heterozygote with a frequency greater than the expected 50%. Such phenomena have been referred to as cases of meiotic drive when the basis is found in some aberration of meiosis. Chromosomes were tested that had received light doses of radiation each generation for about 200 generations. The genetic tests consisted of back-crossing heterozygotes for chromosomes derived from the irradiated populations and for stock chromosomes carrying mutant genes to the mutant stock in order to detect any deviation in the progeny from the expected 50% of each type. Of 1654 tests there were 2 instances in which the chromosomes derived from the irradiated population were recovered in significantly more than 1/2 the progeny, and where this deviation persisted after repeated testing. (NSA 15: 1961, 23317)

962 Olivieri, A., Olivieri, G. DOSE-EFFECT RELATION IN THE INDUCTION OF CROSSING-OVER WITH X-RAYS IN MALES OF *Drosophila melanogaster.* *Atti Accad. Naz. Lincei Memorie Classe di scienze fisiche e matematiche* *34* (1963) 685-95. (In Italian)

Males, 0-24 h old, heterozygote in the 2nd chromosome for *b cn vg bw*, were exposed to x-ray doses of 500, 1000, 2500, and 4000 r. They were bred with *b cn vg bw* females, and the cross-overs found in the descendants of the 7th to the 21st day after irradiation were determined. Results are tabulated and their significance discussed in detail.

963 Olivieri, A., Olivieri, G. INDUCTION OF CROSSING-OVER IN *Drosophila melanogaster* MALES WITH VARIOUS DOSES AND FRACTIONATED DOSES OF X-RAYS. *Atti Ass. genet. ital.* *8* (1963) 181-93. (In Italian).

Studies on the induction of crossing-over in male *D. melanogaster* chromosomes following exposure to various dose rates and fractionated doses of x-rays showed the existence of a stage of greatest sensitivity during spermatogenesis. A significant decrease of induced crossing-over in the centromeric region was observed after exposure to fractionated doses. The possible relation between radio-induced crossing-over and chromosome breaks is discussed. (NSA 17: 1963, 28709)

964 Olivieri, G., Olivieri, A. INDUCED CROSSING-OVER IN MALES OF *D. melanogaster.* (Abstr.) *Int. J. Rad. Biol.* *6*, 4 (1963) 382-3.

Two main hypotheses have been put forward to explain the appearance of "clusters" of crossovers in some male offspring, following radiation. Cluster induction was measured in males irradiated with different and fractionated doses in order to obtain some indications of cluster origin. If clusters are produced by a single gonial crossing-over cluster size should not be affected, which it would be if produced by many crossings-over induced in equally sensitive cells. If the time during which the cells are sensitive is shorter than the interval between different treatments, the single dose-effects should not sum up. A pilot experiment was therefore performed in which males heterozygous b cn vg, 0-24 h old, were irradiated with 500 r, 4000 r and 4000 r delivered in 10 h by 500 r doses (180 kV, 6 mA, 3 mm Al, 300 r/min). The males were mated with 2 females each, on 1, 3, 6, 9, 12, 15, 18, 24, 30 and 36 day after irradiation. In the following experimental results "cluster" is defined as a group of events – occurring in a single individual – lying outside a Poisson distribution. These events are the induced crossings-over that can be referred to the same male according to the number and type of crossovers found in its offspring after restoration of fertility (in our case after the 12th day from irradiation). In the sample of 81 males irradiated with 500 r there were no clusters in the offspring of 17 males, which produced crossovers whose frequency-distribution was of the Poisson type; in the sample of 93 males irradiated with 4000 r, clusters appeared in some of the 46 males which produced crossovers. Even with fractionated treatments clusters have been obtained, but in this case the distribution is more in agreement with the Poissonian type. Moreover, in these two last treatments, the number of males producing crossovers was lower than expected. It thus appears that during spermatogenesis cells show a "sensitive stage" for induced crossing-over. In consequence of the synchronism of maturation, there could be at the same moment several cells in that stage; but, on the other hand, it may be that none of these cells is present in some males at the moment of irradiation. This could show up by giving a high dose of radiation, even in fractionated treatments, if the "sensitive stage" is longer than the interval between the different fractions. A low dose, on the contrary, should not induce a sufficient number of breakages in sensitive cells to produce enough crossings-over to form a cluster. (From abstr.)

965 Oster, I.I., Balaban, G. CYTOLOGICAL DEMONSTRATIONS OF INDUCED BREAKAGE IN SOMATIC CHROMOSOMES OF *Drosophila.* (Abstr.) *Genetics* *47*, 8 (1962) 974-5.

X-rayed and chemical mutagen-treated larvae of *Drosophila* have been shown to exhibit an increase in preimaginal mortality and a decrease in the life-span of the surviving adults. This phenomenon, essentially akin to the premature ageing observed in irradiated mammals, has been shown by several genetic tests to be based on chromosomal loss (Oster 1959; Muller and Ostertag 1959). One of these involved the use of males containing a ring-shaped X-chromosome. Since ring chromosomes are more prone to loss following breakage than normally-constituted chromosomes, males hemizygous for the former are more susceptible to mutagen-induced life-shortening. – Direct cytological observation of this damage would offer additional confirmation for our interpretation based on the breeding results and a simple method for testing other agents as possible mutagens. – By utilizing a combination of techniques recently introduced by E.B. Lewis (Drosophila Inform. Serv., 34) for demonstrating the mitotic chromosomes of *Drosophila* larval ganglia and a lactic-acetic orcein-fast green stain developed by Rudkin and Kamrer (unpublished) we have been able to obtain preparations with 15-20 figures per ganglion in which the full complement of chromosomes can be clearly analysed (Oster and Balaban, Drosophila Inform. Serv., 37). – Preliminary observations have yielded results completely in agreement with the genetic tests, i.e., the relatively high susceptibility to loss following irradiation of ring-shaped chromosomes as evidenced by their breakage and frequent involvement in anaphase bridges. Such effects can also be observed following exposure to relatively low doses of x-rays. – Also this method has been successfully applied to the somatic chromosomes of the housefly.

966 Oster, I.I., Pooley, E., Schwarz, R. SPONTANEOUS AND INDUCED NON-DISJUNCTION IN *Drosophila melanogaster.* *Genetica* *?* 8p. (quoted as "in press" in 1963).

967 Oster, I.I., Pooley, E. THE EFFECT OF ACCESSORY CONDITIONS ON X-RAY INDUCED NON-DISJUNCTION IN Drosophila. Genetica ? 10p. (quoted as "in press" in 1963).

968 Ostertag, W. THE GENETIC BASIS OF SOMATIC DAMAGE PRODUCED BY RADIATION IN THIRD INSTAR LARVAE OF Drosophila melanogaster. Diss. Abstr. 22, 5 (1961) 1356-6.

Somatic damage to larvae can be attributed to loss of chromosomes via the breakage-fusion-bridge-loss process. Females have a higher radioresistance than males through all dosage ranges tested, the differential sensitivity being expressed throughout the subsequent life of the flies until death of the whole irradiated generation. (Note higher radiosensitivity with heterozygous deficiency in one of the second chromosomes. The radiosensitivity of the autosomes is roughly twice that of the X chromosomes. The presence of a ring-X in females heterozygous for it and for a deleted rod, or in males, leads to a higher radiosensitivity than in flies having a normal rod-X in place of the ring. The effect of post-treatment with N_2 increases the differential sensitivity to a level 33% higher than in the irradiated but non-treated larvae. A simple model is developed explaining the action of radiation in producing somatic damage all through the life of the fly (unpublished mathematical model). The present results leave no major role for the cytoplasm or other non-chromosomal components in the causation of somatic radiation damage in Drosophila larvae. Genetic effects other than breakage by radiation could at most play a minor role in the effects described.

969 Puro, J.A. THE BROOD PATTERN OF X-RAY INDUCED CROSSING-OVERS IN Drosophila melanogaster MALES. (Abstr. 5.40) p.69 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol.I". Geerts, Ś.J., Ed. Oxford, Pergamon Press. 1963.

The pattern of induced crossing-overs in D. melanogaster males was studied using a hybrid stock of 12 recessive markers in the third-chromosome. Adult males, after treatment with 3000 r x-rays, were mated singly and sequentially (at 2- or 3- d intervals for the first three broods and daily from the 7th to the 24th d) to females of an appropriate genotype for detecting crossovers. Fertility and fecundity of the treated males, after decreasing to the lowest level on d 8, had a marked recovery on day 10 followed by a small depression on days 11 and 12; no differences between the experimentals and controls were found for any of the rest of the broods. The number of tested F_1 offspring totalled 51 964 from 46 treated and 25 778 from 11 control males. With rare exceptions, proven crossovers were first detected on the 9th d but the highest incidence was on the 10th d after treatment. Clusters of crossovers, many of which continued in several broods, began on the 11th or 12th d. The evidence from the continuing crossover-clusters substantiates the hypothesis proposed by the author (1962) from clusters of recessive third-chromosome lethals, that the treated predefinitive gonia – on an average 5 in number per male, basing the estimation upon the size of clusters – are responsible for the recovery of sperm production to the control level by the 12th d. Furthermore it appears that the high incidence of crossovers, on the 10th d, is the result of induction of crossovers in definitive (secondary) gonia.

970 Ray-Chaudhuri, S.P. INDUCTION OF CHROMOSOME ABERRATIONS IN THE SPERMATOCYTES OF GRASSHOPPERS. Nucleus 4, 1 (1961) 47-66.

X-ray-induced abnormalities in metaphase and anaphase cells are described for meiotic cells of male grasshoppers (Gesonula punctifrons). Independence from dose-rate but a dependence on the wavelength was observed. Different irradiating temperatures (4°C and 37°C) had no effect. An attempt was made to compare aberrations produced by x-rays with those from absorbed P^{32}. A series of experiments are mentioned in which dicentric bridges are used as an index of radiation damage to chromosomes (pre-treatment with sodium azide, versene (ethylenediaminetetraacetic acid), and cysteamine)).

971 Rasmuson, M. UNEQUAL CROSSING-OVER IN THE BAR REGION OF Drosophila melanogaster; INFLUENCE OF TEMPERATURE, X-RAYS AND EDTA. Hereditas 47, 2 (1961) 357-78.

Unequal crossing-over in the Bar segment of D. melanogaster, giving rise to reverted B^+ and BB, were used in a study of induced crossing-over to reveal the possible presence of clusters. High temperature (31°C for 48 h), x-rays (4000 r and 2500 r), and EDTA (a chelating agent known to deprive the organisms of calcium) were used as enhancing treatments. Frequency of crossing-over in the region f -car was registered and compared to the frequency of unequal crossing-over in the Bar segment. High temperature and the higher x-ray dose were found to be effective in raising the frequency of crossover. The lower x-ray dose was without effect and the EDTA treatment was dubious but seemed to enhance the frequency to a small extent in the later broods. Since a significant increase in crossing-over frequency has been observed without the simultaneous presence of clusters, it is inferred that induction of gonial crossing-over with subsequent multiplication of the crossover products is not the cause of the enhancing effect of the treatments. The enhancing effect can be supposed to work directly on the recombination process during pre-meiotic interphase or earliest leptotene, 5-10 d before the delivery of the eggs. This probably holds both for high temperature and the effective x-ray dose. Whether the EDTA effect is exerted in the same manner and at the same time cannot be decided until the treatment becomes more exactly time-limited and quantitative.

972 Sävhagen, R. THE RELATIONSHIP BETWEEN TYPE OF ABERRATION AND SENSITIVITY PATTERN IN IRRADIATED Drosophila melanogaster MALES. Hereditas 47 (1961) 190-6.

Differences between sensitivity patterns for various types of induced genetic damages were compared and found to reflect the relationship between the different mechanisms at work in producing damages and the cell stage treated. It was concluded that there exists not only a marked difference in sensitivity to irradiation between various stages of spermatogenesis in Drosophila, but also a difference in sensitivity according to which type of aberration is studied. It is also obvious that the changes in sensitivity are delimited to very short intervals during spermatogenesis. (NSA 16:1962, 17468)

973* Sengün, A. EFFECTS OF X-RAYS ON SALIVARY-GLAND CHROMOSOMES DURING EARLY STAGES OF DEVELOPMENT. Nucleus 1 (1958) 162-72.

Embryos of Drosophila melanogaster (4-6, 10-12, and 16-18 h old), larvae (22-24, 58-60 h old) and older 3rd-instar larvae were irradiated with ~3500 r x-rays. Chromosomes from the salivary gland, midgut, and Malpighiantubule cells were examined in aceto-orcein or in aceto-carmine smear preparations made from old 3rd-instar larvae and pre-pupae. In salivary-gland chromosome preparations from larvae irradiated at the age of 4-6, 10-12, 16-18, and 22-24 h some structural abnormalities ("partial rearrangements" of Slizynski) were observed. They could be regarded as partial inversions, translocations and deficiencies. The nature of these rearrangements is discussed.

974 Slizynska, H. ORIGIN OF REPEATS IN Drosophila CHROMOSOMES. Genet. Res. 4 (1963) 154-7.

Rp, a type of duplication where a segment of one chromatid is inserted next to its homologous segment in the sister chromatid, are induced by x-rays at a very low frequency and some chemical mutagens are capable of inducing Rp's with a high frequency. Attempts were made to deduce the mechanism responsible for the origin of Rp's from a cytological study of different types of Rp and their relative frequencies, based on x-ray and formaldehyde-induced Rp's in D. melanogaster. Four types of Rp were found during cytological analysis of the effects of formaldehyde food, and all can be explained by a mechanism which requires two breaks in a still undivided chromosome; after splitting of the chromosome, these breaks result in two pairs of isochromatid breaks. Depending on the type and the number of new rejoinings, different types of Rp are formed. All of them are accompanied by the same complementary deficiencies (Df). In order to result in a Rp with complementary Df, the breaks have to fulfil special conditions. A proposed model for the origin of repeats suggests that these may arise most readily from chromosome breaks which remain latent (potential) until separation into sister chromatids. This is in excellent agreement with the fact that formaldehyde, which produces mainly potential breaks, yields a high frequency of Rp's, while x-rays yield very few. (From NSA 18:1964. 11728)

975 Sokoloff, A. STUDIES ON FACTORS AFFECTING CROSSING OVER IN Tribolium castaneum. Tribolium Inform. Bull. 6 (1963) 57-60.

In one series of experiments 14 males and 8 females (genetically Be s/++) were exposed to 3210 r of x-rays (1070 r/min through a 1 mm Al filter). The irradiated beetles were mated to a number of s/s beetles corresponding to the number in the controls, and their progeny reared in the same incubator as the controls. Irradiation results in a marked drop in productivity, especially in females. The frequency of crossing over for irradiated females is comparable to that obtained for the controls. On the other hand, Chi square tests for homogeneity for other tests suggest that the increase in crossing over in the males as a result of irradiation is real. With irradiation, crossing over is increased in frequency in the male but not affected in the female. It is modified by age, but probably only in the male.

976 Strangio, V.A. RADIOSENSITIVITY TO CERTAIN BREAKAGE ABERRATIONS DURING SPERMATOGENESIS IN Drosophila melanogaster. Drosophila Inf. Serv. 35 (1961) 96-8.

977 Tikhomirova, M.M. AFTER-EFFECT OF ROENTGEN RAYS UPON PRIMARY NON-DISJUNCTION OF X-CHROMOSOMES. p. 198-202 in "Pervichnȳe Mekhanizmȳ Biologicheskogo Deĭstviya Ioniziruyushchikh Izlucheniĭ". Moscow, Publishing House of the Academy of Sciences. 1963. (In Russion).

The question of whether the radiation effect is confined only to the recorded genetic effect observed under ordinary conditions or whether there arise in the cells potential changes revealed only upon additional treatment is discussed. The frequency of primary non-disjunction of X-chromosomes was followed up for Drosophila irradiated with 3000 r and subsequently exposed to +37 °C during 8 h after various time intervals. It is concluded that the phenomenon of radiation after-effect upon the disjunction of chromosomes does exist. (Auth.)

978* Traut, H. ON THE IDENTIFICATION OF RADIATION INDUCED DELETIONS OF THE X-CHROMOSOMES OF D. melanogaster. Drosophila Inform. Serv. 34 (1960) 109.

979 Traut, H. THE LINEAR DOSE-DEPENDENCE OF RADIATION-INDUCED TRANSLOCATION FREQUENCY IN Drosophila melanogaster AT RELATIVELY LOW X-RADIATION DOSES. Int. J. Rad. Biol. 7, 4 (1963) 401-3.

Sperm stored in females, which can be considered the most homogeneous germ-cell stage available in Drosophila, were irradiated with 150 kV x-rays, at 500 r/min. The statistical test based on weighted regression analysis shows no indication for departure from linearity for the dose-range from 0-0.5 kr ($P = 0.70$), while there is a high degree of significance for the linear term ($P = 10^{-10}$). The experimental points can be fitted by the equation $y = 0.071 + 1.16\,x$ (y = translocation frequency in percentage, x = exposure in kr). Results of work using γ-and neutron radiation are considered; it appears that in the low dose-range, neutrons are much more efficient in the production of two-break chromosome aberrations than x- and γ-rays.

980 Uchida, I.A. THE EFFECT OF MATERNAL AGE AND RADIATION ON THE RATE OF NON-DISJUNCTION IN Drosophila melanogaster. Canad. J. Genet. Cytol. 4, 4 (1962) 402-8.

Virgin females were aged from 1-29 d before exposure to 1650 r of γ radiation. Yellow body (y) was used as the non-disjunction marker on the X chromosome. There was a 7-fold increase in the frequency of exceptional flies among the progeny of irradiated females compared with the controls. There is no evidence of an increased rate of non-disjunction with aging in the absence of radiation. In the irradiated series there is a positive correlation between the rate of non-disjunction and maternal age. (Auth.)

980-a Wallace, B. ON RELATIVE VIABILITY AND REPLACEMENT. Proc. nat. Acad. Sci., Wash. 50 (1963) 514-24.

A type of replacement exists that could seriously alter the outcome of studies on the viability of irradiated X chromosomes. Conditions under which the replacement could occur were defined, and a search was made for this kind of replacement by comparing the number of Drosophila melanogaster of various genotypes emerging in comparable lethal and nonlethal cultures. Approximately 5000 control and irradiated X-chromosomes were tested. Levels of radiation used were 500, 1000, and 2000 r of x-rays. A total of 77 lethals were recovered among irradiated cultures, for which 77 non-lethals were chosen for comparative analysis. It was found that heterozygous females carrying an irradiated chromosome do not possess a unique replacement ability. Lethal heterozygotes have somewhat impaired viabilities, but there is no evidence in this data that replacement of the sort that causes spurious ratios occurs in the tests involving the X-chromosome. Evaluations are made of suggestions on experimental data interpretations. (NSA 17 : 1963, 40601)

981 Warters, M. X-AUTOSOMAL TRANSLOCATIONS OF Drosophila melanogaster. (Abstr. B1A341) p. 31 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

Translocation studies on Drosophila melanogaster have shown that a high degree of sterility can be expected in the male if the X-chromosome is involved in the translocation. The investigation underway was designed to determine the amount of sterility to be expected and, if possible, the factors responsible. A special procedure had to be designed which would permit the recovery of the induced translocations through the F_1 females of irradiated parents rather than through the F_1 males which is the standard method. The new technique proved very effective in recovering both male sterile and male lethal classes of X-autosomal translocations which otherwise would have been lost through the haploid male. A sample of 180 X-autosomal translocations has been obtained of which 78 are T(X; 2)'s; 66 T(X; 3)'s and 36 T(X;2;3)'s. Of the first two classes approximately 19% of the males fail to survive and 75% of the viable males are sterile. Cytological studies are now under way to determine whether a correlation can be found between the break-points on the chromosomes and sterility. Evidence from some studies would lead to the hypothesis that any interruption in the continuity of the X-chromosome would lead to sterility. This has not been confirmed by the analysis of half of the sample of translocations.

982 Whittinghill, M., Davis, D.G. INCREASED RECOMBINATION FROM FEMALE Drosophila IRRADIATED AS LARVAE WITHOUT OÖCYTES. Genetics, 46 (1961) 357-60.

Different x-ray doses to late 3rd instar larvae of Drosophila produced elevated frequencies of crossovers only from eggs laid in the 1st week of the imagoes. 3 broods from 8-to 21-d-old adults were homogeneous among control and 3 irradiation dosage groups. Comparison of non-crossover and crossover frequencies showed no evidence of radioresistant cells among the oögonia present in x-rayed larvae. Higher crossover and lower non-crossover values were found in the 14-to 21-d brood rather than in the earliest brood of the controls. This response of Drosophila and the lack of such response of Habrobracon to irradiation are discussed. (Auth.)

983 Whittinghill, M., Allen, A.C. UNCHANGED RECOVERY OF CROSSOVERS AFTER X-IRRADIATION OF PUPAL Habrobracon. Genetics 46, 6 (1961) 581-4.

To find whether recombination could be increased in H. juglandis by heavier irradiation than is necessary in Drosophila and to concentrate on gonial cells as "targets", white pupae were given 1000 r, 2500 r, or 4000 r, and the resulting adult females were placed as virgins with fresh hosts every 2nd day for 9 transfers or more. Fertility of control, 1000 r, and 2500 r categories was high, and it was reduced only in the 4000 r females. Crossover values in the black-lemon-canteloup-honey regions showed no significant change with treatment, or with age or between individual families. The lack of radioresponse and the lack of age changes are perhaps caused by the lack of somatic pairing of chromosomes in the Hymenoptera. (Auth.)

984* Wolff, S. CHROMOSOME BREAKAGE AND REJOINING IN IRRADIATED SPERM OF Drosophila. (Abstr.) Genetics 44, 4 (1959) 545.

985 Wolff, S. CHROMOSOME SPLITTING AS REVEALED BY COMBINED X-RAY AND LABELING EXPERIMENTS. (Abstr. B1A1001) p. 60 in "Research and Development in Progress. Biology and Medicine. Issue No. 2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Cells were either labelled by a short treatment with H^3-thymidine and then x-rayed, or x-rayed and subsequently labelled. Cells were sampled as they reached metaphase at successively later times and scored for the type (chromosome or chromatid) of aberration present and whether labelled. The fact that the chromosome reacts as though double in the very early part of DNA synthesis even though the majority of the DNA is not added to the chromosome until later suggests that the protein moiety rather than the nucleic acid contributes to the linear continuity. Experiments in which attempts had been made to label the chromosomal protein during duplication were unsuccessful because labelled amino acids are incorporated into nuclear proteins throughout interphase, making it impossible to distinguish those cells in which the protein was doubled.

986 Wolff, S. THEORETICAL KINETICS FOR TWO-HIT CHROMOSOME EXCHANGES. (Abstr. B1A1002) p. 60-1 in "Research and Development in Progress. Biology and Medicine. Issue No. 2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Expressions for the yield of two-hit exchanges have been derived. The theoretically expected values from these give very good fits to existing Tradescantia, Drosophila, and human chromosome data without necessitating the interposition of extraneous factors to account for the shape of the curves.

987 Zimmering, S. GENETIC EVIDENCE OF X-RAY-INDUCED EXCHANGES OCCURRING AT A FOUR-STRAND STAGE IN Drosophila SPERMATOCYTES. J. Hered. 53 (1962) 254-6.

Evidence is presented that x-ray-induced exchanges between X and Y chromosomes occur at a 4-strand stage in spermatocytes D. melanogaster. The evidence consists of the recovery of certain exceptional female progeny that received both of their X chromosomes from the irradiated male parent, one of these being a crossover and the other a non-crossover chromosome.

988 Zimmering, X., Wu, C.K. RADIATION INDUCED X-Y EXCHANGE AND NONDISJUNCTION IN SPERMATOCYTES OF THE IMMATURE TESTIS OF *Drosophila*. *Genetics* *48* (1963) 1619-23.

The x-irradiation response of primary spermatocytes of the immature testis of *D. melanogaster* was investigated employing a genetic scheme which made possible an immediately classifiable distinction in the offspring between nondisjunction of X and Y, and exchange between X and Y in the treated male. (NSA 18:1963, 5047)

See also:

103 Terrestrial and fresh-water ecology – radiation effects on *Chironomus tentans*. (Auerbach, 1963)
121 Radiation effects on biota. (Morton, 1961)
122 Radiation effects on biota – estimated radiation dose received by Diptera with life stages in bottom sediments. (Morton, 1962)
179 Radioisotopes and the genetic mechanism: cytology and genetics of divalent metals in nuclei and chromosomes. (Steffensen and LaChance, 1960)
479 Cytogenetic studies of x-ray and ingested P^{32} induced sex-linked recessive lethals in *Drosophila melanogaster*. (Walen, 1962)
753 Ionizing radiations and the induction of chromosome mutations in the germ cells. (Ray-Chaudhuri, 1961)
760 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1961)
770 The induction of mutations in spermatocytes of *Drosophila melanogaster* with x-rays. (Chandley, 1962).
771 Developmental-genetic study of the effect of x-ray irradiation in *Drosophila virilis* and *Bufo valliceps*. (Clayton, 1961)
787 Genetic and direct effects of gamma radiation on *Drosophila*. (Ives, 1963)
824 The role of recovery mechanism and oxygen effects upon changes in radiation sensitivity in sperm treated in mature males and fertilized females of *Drosophila*. (Alexander, 1962)
838 X-ray induced sex-linked recessive lethals and visibles in Sciara (i.e. *Bradysia*) *coprophila*. (Crouse, 1961)
851 Structure of "yellow" mutations induced by x-rays of $scute^8$ chromosomes of different germ cells in *Drosophila melanogaster*. (Frye, 1961).
863 Cytological effects of x-rays in relation to dose-rate in *Drosophila melanogaster*. (Gunson, 1962)
882 The correlation between radiation-induced male sterility and reciprocal translocation in *Drosophila*. (Lindsley *et al.*, 1962)
901 Radiation and mutation rate. (Stern, 1963)
913 Studies of mutation and of recombination in the same chromosomes of irradiated female *Drosophila melanogaster*. (Whittinghill, 1963)
989 The immediate cytological effects of ionizing radiations. (Carlson, 1958)
1000 Mutagenic sensitivity of sperm, spermatids, spermatocytes, and spermatogonia in *Drosophila melanogaster*. (Chandley and Bateman, 1961)
1002 Effects of x-ray irradiation in *Drosophila virilis* at different stages of spermatogenesis. (Clayton, 1962)
1013 A cytogenetic study of the effects of x-irradiation on *Aedes aegypti*. (Rai, 1963)
1017 The relation between the rate of induced translocations and treated cell stages in males of *Drosophila melanogaster*. (Sävhagen, 1960)
1018 The relation between x-ray sensitivity and stages of development of treated cells in spermato- and spermiogenesis of *Drosophila melanogaster*. (Sävhagen, 1961)
1019 Cell stages and differential sensitivity to irradiation in males of *Drosophila melanogaster*. (Sävhagen, 1963)
1023 Radiosensitivity during spermatogenesis in *Drosophila melanogaster*. (Strangio, 1962)
1026 The effect of asynapsis on mutability in the testis of *Drosophila*. (Thompson, 1961)
1027 Asynapsis and mutability in *Drosophila melanogaster*. (Thompson, 1962)
1028 Synaptic modification of dominant lethal frequencies after irradiation of the *Drosophila* testis. (Thompson, 1962)
1038 Biological damage in the mature sperm of *Drosophila virilis* in oxygen and nitrogen with different dose intensities of gamma rays. (Alexander and Bergendahl, 1962)
1042 Radiation sensitivity in sperm treated in males and inseminated females of *Drosophila* with x-rays in nitrogen and air. (Alexander and Bergendahl, 1962)

1058 Nitrogen-treatment effects on rearrangement-induction patterns in *Drosophila melanogaster*. (Falk, 1961/2)
1083 AET and MEA as protection against radiation induced chromosomal aberrations in *Drosophila*. (Mittler, 1963)
1087 Differential yields of mutations from the first and second matings after irradiation of mature sperm in *Drosophila melanogaster*. (Mossige, 1963)
1093 Phase cinematography studies on the effects of radiation on the cell, with special regard to the behaviour of the chromosomes in grasshopper spermatocytes in response to x- and beta-irradiations. (Nakanishi *et al.*, 1961)
1098 The mutational spectrum with special reference to the induction of mosaics. (Oster, I.I.)
1099 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)
1100 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)
1113 Protective action of Versene against radiation damage to grasshopper chromosomes. (Ray-Chaudhuri and Saha, 1960)
1114 Cysteamine protection of grasshopper chromosomes from x-ray-induced aberrations under aerobic and anaerobic conditions. (Ray-Chaudhuri *et al.*, 1962)
1115 The genetical response of radiation spermatozoa to different types of radiation treatment. (Reddi, 1963)
1121 The frequency of XO males and induced autosomal crossovers after irradiation of *Drosophila melanogaster* males in air or commercial nitrogen. (Sävhagen, 1961)
1122 The effect of oxygen concentration on the frequency of induced XO males and non-disjunction females after irradiation of *Drosophila* males. (Sävhagen, 1961)
1150 Dose-dependence of radiation-induced mutation rate in *Drosophila melanogaster* depending on the stage sensitivity of the irradiated germ cells. (Traut, 1962)
1151 A study of dose-dependence of radiation-induced mutation rates in *Drosophila melanogaster*, allowing for the degree of maturity of the germ cells. (Traut, 1962)
1152 Dose dependence of the frequency of radiation induced recessive sex-linked lethals in *Drosophila melanogaster*. (Traut, 1963)
1162 The influence of oxygen on the frequency of radiation-induced chromosome aberrations in oöcytes of *Drosophila melanogaster*. (Wind and Traut, 1961)
1163 The effect of roentgen rays and of high temperature upon the crossing over process. (Zakharov and Inge-Vechtomov, 1963)
1173 Cytogenetic investigations on the nature of dominant lethals induced in meiotic oöcytes by gamma radiation and alkylating agents. (LaChance and Riemann, 1963)
1328 A quantitative study of lifetime sickness and mortality and progeny effects resulting from exposure to penetrating irradiation. (Gowen and Stadler, 1962)
1342 X-ray-induced mutations in *Anopheles maculipennis*. (Frizzi and Jolly, 1961)
1353-a The genetic basis of somatic damage produced by radiation in third instar larvae of *Drosophila melanogaster*. I. Death before maturity. (Ostertag, 1963)
1388 Chromosomal aberrations in a natural population of *Chironomus tentans* exposed to chronic low-level environmental radiation. (Blaylock, 1963)
1393 Chromosomal polymorphism decrease due to γ radiation on natural populations of *Drosophila willistoni*. (Cordeiro, 1961)

I-A-5 MITOTIC AND MEIOTIC STAGE SENSITIVITY

General

989* Carlson, J.G. THE IMMEDIATE CYTOLOGICAL EFFECTS OF IONIZING RADIATIONS. *Bios* *29*, 3 (1958) 108-17.

"Immediate" effects appear as chromosome "stickiness", mitotic inhibition, chromosome aberration, and cell death. Neuroblast (grasshopper) appear particularly resistant to immediate lethal effects. The degree of stickiness appears to depend on the mitotic stage of the cell at irradiation, and on the dose given. The earlier the stage, the smaller the required dose. Mitosis in the neuroblast is highly sensitive to even very low doses. Irradiation-induced mitotic retardation is considered to be a temporary effect, from which the cells recover completely. Chromosome aberrations (single breaks, inversions, and translocations) and the ability of a cell to survive ionizing radiations are discussed.

990 Carlson, J.G. THE GRASSHOPPER NEUROBLAST CULTURE TECHNIQUE AND ITS VALUE IN RADIOBIOLOGICAL STUDIES. *Ann. N.Y. Acad. Sci.*, Wash. *95*, 2 (1961) 932-40.

Review article. Since Chortophaga viridifasciata De Geer has no diapause it is a particularly convenient grasshopper. Interest has been centred on neuroblast mitosis and on the effects of different kinds of radiation on mitosis and on the structure and behaviour of various parts of the dividing cell. The technique described can be adapted to different kinds of radiation. In x- and γ-ray experiments the cells may be irradiated within the intact egg chorion and made into a hanging-drop preparation a selected interval of time later, or they may be irradiated in a hanging drop. For α-particles it is necessary to substitute thin mica for the cover glass. For β-radiation the embryo is oriented with the ventral side downward against a rubber hydrochloride membrane forming the bottom of a small dish containing culture medium and treated by inserting a P^{32} Bakelite plaque beneath it. After irradiation the embryo is mounted in a hanging-drop for observation. For ultraviolet radiation a quartz cover is substituted for the glass cover, and the neuroblasts on one side of the mid-ventral line of the embryo are shielded with film or black paper to serve as controls. The advantages and shortcomings of the method are described, also the effects of ionizing and ultraviolet radiations. 26 references.

991 Whiting, A.R. CONTRASTS IN RADIATION-INDUCED MUTATION RATES AT DIFFERENT MEIOTIC STAGES. p.183-95 in "Strahlenwirkung und Milieu (Radiation Effect and Milieu). Internationales Radiobiologisches Symposium in Montreux vom 28. Mai bis 3. Juni 1961". Fritz-Niggli, H., Ed. München, Urban and Schwarzenberg. 1962.

Review article. Results obtained with Drosophila, mouse and Habrobracon are emphasized, with reference made to relevant data on Mormoniella, Apis, Sciara and Bombyx. As the basis for comparison between stages and species, radiation-induced dominant lethal rates are used, when available. The article is broadly divided into sections on spermatogenesis, and oögenesis, with some mention of the oxygen effect in a brief paragraph at the end. Close on 80 references are given, ranging from 1932 to 1961.

992 Абелева, Э.А., Бельговский, М.Л., Потехина, Н.А. ВОЗНИКНОВЕНИЕ МУТАЦИЙ В НЕОБЛУЧЕННЫХ ХРОМОСОМАХ ЯЙЦЕКЛЕТОК, ОПЛОДОТВОРЕННЫХ ОБЛУЧЕННЫМИ МУЖСКИМИ ГАМЕТАМИ. Радиобиология 1, 1 (1961) 123-7.

Abeleva, E.A., Bel'govskiĭ, M.L., Potekhina, N.A. OCCURRENCE OF MUTATIONS IN NONIRRADIATED CHROMOSOMES OF OVICELLS FERTILIZED BY IRRADIATED MALE GAMETES. Radiobiology 1, 1 (1961) 373-86. JPRS-10170, 18 Sept. 1961. Translation from Radiobiologiya 1, 1 (1961) 123-7.

Mutations in the chromosomes of non-irradiated ova of Drosophila fertilized with male gametes in non-irradiated chromosomes suggest a possible prolonged preservation and transmission of energy from one structure to another. The effect is not peculiar to the particular structure of the chromosome where such mutations occur. Contrary to observations on irradiated chromosomes, the effect (which had been subjected to 2000 r, at 336-384 r/min x-rays) is greater when sperm rather than spermatids have been irradiated. The general effect of radiation (sum of mutation frequencies in irradiated and non-irradiated chromosomes) is the same for irradiation of sperm or spermatid.

993 Abeleva, E.A., Potekhina, N.A. THE RADIATION SENSITIVITY OF VARIOUS STAGES OF SPERMATOGENESIS IN Drosophila melanogaster. (Abstr.) Soviet Bloc Mainland China Tech. J., Ser. VI Bio-Sci. 61-11 145, 26 (1963) n.p. (With English summary)

The frequency of dominant lethals on repeated irradiation of Drosophila sperm and spermatids was studied to elucidate the reversibility of physiological damage and the mutagenic effects of repeated low dose radiation. Male F_1 hybrids of Algerian and Erebro strains (24 h old) received (1) 2400 r in one dose or 3×800 r at 1 1/2 h intervals, and (2) 400 r and 1200 r in a single dose or 3×400 r at 3 h intervals. In (1), since no difference was discerned between single and repeated doses, the interdose interval was increased to 3 h and the doses were changed to 1200 r maximum and 400 r minimum. As anticipated, repeated radiation did not affect the frequency of dominant lethals in the sperm. In spermatids the rate fell by 4.55%, suggesting recovery of the damaged chromosomes. The absence of effect after repeated radiation is not considered a decisive refutation of Russell's hypothesis. A linear relationship between dose and the frequency of dominant lethals is shown to exist up to 1000 r, and the similarity in the frequency pattern of dominant and recessive lethals is pointed out. The spermatid-sperm mutation rate ratio increases with dose reduction, changing from 3:4 at 1000 r to 4:5 at 400 r and to 5 at 20 r. Small doses exert, therefore, a large effect on spermatids. These effects are discussed in relation to man and the length of the various stages of spermatogenesis. The danger of damage during very short, but highly radiosensitive stages is emphasized. There are 2 tables. (Auth.)

994 Baldwin, W.F. LATENT RADIATION DAMAGE AND SYNCHRONOUS CELL DIVISION IN THE EPIDERMIS OF AN INSECT. III. SPONTANEOUS REVERSAL OF EFFECTS LEADING TO DELAY DURING MITOSIS. Rad. Res. 14 (1961) 426-31.

Moulting in the insect Rhodnius, order Hemiptera, is initiated by a single meal of blood. After the meal, and in response to a stretching stimulus from the abdomen, neurosecretory cells of the insect brain produce a secretion that activates the thoracic gland, which produces the moulting hormone. Whole-body irradiation was found to delay initiation of division in nymphs. Exposures of 9000 r from a 2-MeV x-ray machine were given. Results of studies on 4th-stage nymphs irradiated over the abdomen only indicate the spontaneous reversal of a part of the latent radiation damage. Reaction mechanisms involved are discussed.

995 Baldwin, W.F. NON-REPAIRABLE AND REPAIRABLE SOMATIC EFFECTS OF IRRADIATION IN INSECTS. p.7 in "Radiation Biology in Canada 1962-63". CRB-1129, AECL-1701, Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 1963. 60p.

To determine the precise relationship between the delayed expression of radiation injury and the time of onset of post-irradiation cell divisions, the effects of irradiation on the epidermal cells of the blood-sucking insect Rhodnius are being studied. Cell division in the epidermis underlying the outer cuticle of this insect occurs only at 5 d after feeding on blood and the divisions are essentially synchronous throughout the whole epidermal layer. Thus it is possible to irradiate in the non-dividing state and then force the cell divisions to occur at any desired time after the exposure by allowing the insect to feed. (From auth.)

996 Borstel, R.C. von. THE GENETIC BASIS FOR X-RADIATION-INDUCED MITOTIC INHIBITION. (Abstr. 21) Rad. Res. 14 (1961) 453.

In Drosophila, most of the embryonic deaths from x-irradiation of the sperm occur during the first few mitotic divisions after meiosis. An easily recognizable syndrome follows: Numerous (usually 8 to 16, although the ranges are from 3 to about 100) polyploid nuclei are found throughout the egg. Many of the nuclei appear to be lying in spindles with chromosomes disoriented. It has been shown that this type of death cannot be accounted for by loss of chromosomes, inactivation of nucleoli, nor by loss of chromosome parts. The author believes that chromosomal bridges, derived either by radiation or genetically, act not through eventual loss of essential genes by bridge-breakage, but by drastic slowing of the rate of mitosis. Unfertilized Drosophila eggs will not proceed in development as far as eggs fertilized with irradiated sperm. This mitigates against the possibility that eggs fertilized by irradiated sperm are behaving like unfertilized eggs. (From abstr.)

997 Borstel, R.C. von. STAGE SENSITIVITY TO X-RADIATION DURING MEIOSIS AND MITOSIS IN THE EGG OF THE WASP Habrobracon. (Abstr. B1A996) p.59-60 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

A dose of 500 r was chosen since it approximates the 50% hatchability dose of eggs in the 1st meiotic metaphase in the female. Eggs older than 1 min from oviposition were discarded. To slow down the rate of nuclear division the embryos were kept at 20°C until irradiated. Control embryos were fixed in cold Kahle's fixative and stained to permit accurate cytological staging. Each embryo was timed to within 1 min. Data were collected for metaphase I of meiosis, anaphase I through anaphase II of meiosis, post-anaphase II and pronucleus, prophase I of mitosis, metaphase I of mitosis, and later stages.

998 Borstel, R.C. von., Amand, W.St. STAGE SENSITIVITY TO X-RADIATION DURING MEIOSIS AND MITOSIS IN THE EGGS OF THE WASP Habrobracon. p.87-100 in "Repair from Genetic Radiation". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

After reviewing reported radiation effects on (pre-oviposition) eggs the authors describe radiation effects of a dose of 500 r administered post-oviposition. Problems related to stage sensitivity during meiosis and during karyokinesis are discussed, also genetically non-transmissible damage and a "nuclear re-activation" effect, demonstrated with ultraviolet radiation. Five types of nuclear damage can be distinguished (I-death after one or several nuclear divisions; II and III - death after numerous nuclear divisions; IV-death and pyknosis soon after irradiation; V-dominant lethality expressed in eggs after irradiation in the gonial stage). The syndromes and probable basis for such damages are discussed.

999 Carlson, J.G. STUDIES OF EARLY EFFECTS OF RADIATION ON CHROMOSOMES AND MITOSIS. (Abstr. B1A274) p-30-1 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

The proposed study will consist of three main projects: Electron microscope studies of the early morphological effects of x-rays on the internal structure of the chromosome. Grasshopper neuroblasts will be fixed at different time intervals up to 1 h after x-raying to discover whether changes in the internal structure of the chromosome can be detected. Studies to determine whether recovery from x-ray-induced chromosome damage is accompanied by DNA synthesis. Selected neuroblasts will be irradiated in vitro in any of 15-20 identifiable stages of the mitotic cycle, exposed to radioactive precursors at a desired stage for a given length of time, fixed and made into squash preparations when they are in the desired stage, and autoradiographed. Effects of certain wavelengths of monochromatic uv radiation on incorporation of tritiated precursors into the grasshopper neuroblast chromosome. The methods used will be similar to those of the preceding project. In addition to DNA synthesis, it is our intention to study also protein synthesis by means of radioactive precursors.

1000 Chandley, A.C., Bateman, A.J. MUTAGENIC SENSITIVITY OF SPERM, SPERMATIDS, SPERMATOCYTES, AND SPERMATOGONIA IN Drosophila melanogaster. Heredity 15 (1961) 363-75.

Freshly eclosed males were given 1000 r x-rays and then mated continuously with 2 females/male/d. Mating on days 2, 5, 8 and 11 from irradiation were analysed for dominant lethals, translocations, autosomal and sex-linked recessive lethals, deleted X's and induced crossing over. Day 5 showed the peak sensitivity for translocations and recessive lethals. There was a plateau including days 5 and 8 for dominant lethals. Day 8 showed the peak sensitivity for deleted X's and for induced crossing over which in the latter case continued at a high level subsequently. A low incidence of crossing over on days 6 and 7 indicates that these must represent a diploid stage (probably spermatocytes) at irradiation. It is thus possible to identify the main sampling times with the irradiated stages then being sampled: day 2 - mature sperm; day 5 - early spermatids; day 8 - early spermatocytes or late spermatogonia; day 11 - spermatogonia. (Auth. summ.)

1001 Chandra, H.S. INVERSE MEIOSIS IN TRIPLOID FEMALES OF THE MEALY BUG, Planococcus citri. Genetics 47, 8 (1962) 1441-54.

The sequence of meiotic divisions, the first usually being reductional and the second, equational, has been demonstrated to be inverted in a mealybug, using triploid females. Such females were prepared routinely by irradiating adult males with 90 000 rep γ-rays (Co^{60}-source). At first anaphase in the triploid there was always a 15 : 15 separation of chromatids; the diffuse nature of the kinetochore permits such a numerically equational separation. Reduction is accomplished in the 2nd division in which there is evidence for re-association or "secondary pairing" of the homologous chromatids into triads or dyads in most of the oöcytes. The maternal contribution to the zygote following 3N♀×2N♂ matings was studied in 272 embryos. There was a significant bias in distribution in favour of lower chromosome numbers. It is suggested that the bias is probably real, and based on a definite tendency of triploid mothers to deliver fewer chromosomes to the egg than to the second polar body.

1002 Clayton, F.E. EFFECTS OF X-RAY IRRADIATION IN Drosophila virilis AT DIFFERENT STAGES OF SPERMATOGENESIS. p.345-73 in "Studies in Genetics. II. Research Reports on Drosophila Genetics, Taxonomy and Evolution". Wheeler, M.R., Ed. Austin, The University of Texas. 1962.

Dominant lethals and translocations from x-ray exposure of larvae, pupae, and adults were determined for successive 2-d mating periods. Results indicated that spermatids are highly susceptible to radiation damage; meiotic stages and mature spermatozoa are also sensitive periods, with greatest resistance to chromosome breakage among spermatogonia. Histological analysis of testes collected at intervals following irradiation of larvae, pupae, and adults revealed decreases in all types of meiotic cells followed by recovery to the control level in some tests. Radiation by 1089 r resulted in delay in emergence of adults by ~2 d. Phase-contrast microscopy, aceto-orcein smears, and histological analysis of sections from adult males were used for studying spermatogenesis. Cell counts from adults indicate a 2-d cycle in meiosis until the males are sexually mature. There appear to be steadily diminishing peaks in the mean numbers of primary spermatocytes in pupae just before emergence, and in adults of 2, 4, and 6 d. Spermatozoa of D. virilis are not motile or functional until the 6th day; females were not inseminated and no fertile eggs recovered prior to this.

1003* Davis, D.G. INCREASED RECOMBINATION FROM Drosophila FEMALE X-RAYED BEFORE THE PRESUMED ONSET OF MEIOSIS. Proceedings of the 57th Annual Meeting of the North Carolina Academy of Science, 1960. J. Elisha Mitchell sci. Soc. 76, 2 (1960) 193.

1004 Ives, P.T. SOME EFFECTS OF COBALT-60 GAMMA RADIATION ON PREMEIOTIC SPERMATOGENIC CELLS IN Drosophila melanogaster. (Abstr.) Amer. Zool. 1 (1961) 361.

1005 Ives, P.T. PATTERNS OF SPONTANEOUS AND RADIATION INDUCED MUTATION RATES DURING SPERMATOGENESIS IN Drosophila melanogaster. Genetics 48, 8 (1963) 981-95.

Daily patterns of mutational response to γ-rays were determined for 3 types of young, adult, heterozygous, Oregon-R males which were mated exhaustively during days 1 to 12 after irradiation. Dose of 250 r, 500 r, and 1 kr were tested for the production of dominant visible and sex-linked hemizygous mutations, and 1 kr for Y and autosomal translocations. Translocations were also scored in tests of irradiated mature sperm, and of sperm maturing 5 to 6 d later, after doses of 250 r, 500 r, 2 kr and 4 kr. A linear relationship with dose is indicated for the rates of all types of induced point mutations in sperm from days 1-6. In premeiotic stages of spermatogenesis the relationship varies between dosage levels and between the types of heterozygous males tested. After 1 kr, day-5 sperm showed 3.7 times more sex-linked mutations than appeared in sperm from days 1 and 1-3 and day-6 sperm showed 11.6 times more translocations. Changes in mutation frequency (days 1-6) thus appear to reflect changes in the rate at which both point mutations and chromosome rearrangements occur in the various stages of spermatogenesis from meiosis to maturity. The rate of translocations increases at ~1.6 power of the increase in dose in both mature sperm and sperm maturing 5-6 d after irradiation, and the rate of point mutations increases clearly at both of those times. This supports the view that the mutation process does not change during the meiosis-to-maturation period of spermatogenesis. At the time of peak response in meiosis-spermiogenesis, as well as in mature sperm, after 250 r to 1 kr, dominant visibles appear to be a mixture of point and position-effect mutations. Peak mutation rates appear to be associated with specific stages in spermatogenesis. (From auth. summary)

1006 Kvelland, I. RADIOSENSITIVITY IN DIFFERENT STAGES OF SPERMATOGENESIS IN Drosophila melanogaster. Hereditas 48 (1962) 220-42.

The relative radiosensitivity in different stages of spermatogenesis in D. melanogaster was investigated by studying the sensitivity pattern for different kinds of mutations, i.e. visibles, sex-linked lethals, II-III translocations, and induced crossovers in males. The time required for spermiogenesis, i.e. the time from meiosis to fully mature sperm was considered to be about 6-7 d at 25°C in adult males. The following peaks in frequency were obtained, stated as number of days after irradiation: recessive sex-linked lethals - 5; translocations - 7; visibles - 5; periods of excessive sterility (under experimental conditions) - 7 and 8, or 8 and 9. The radiosensitivity of fully mature sperm was seen to be somewhat higher than that of nearly mature sperm. With further immaturity an increasing sensitivity was observed for all effects studied up to 5 and 6.

1007 Lindsley, D.L., Edington, C.W., Halle, E.S. von. THE EFFECT OF GAMETIC GENOTYPE ON THE RADIATION SENSITIVITY OF Drosophila SPERM. p.63-76 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Irradiation of Drosophila males may produce a shift in the ratios of the different genotypes recovered among the progeny. A method was developed for treating progeny ratios following paternal irradiation as the ratio of two survival functions, where survival refers to the ability of a mature sperm of a particular genotype to produce an adult fly in the next generation. Although chromosome loss and among-experiment variability contribute imprecision to the model as it stands, the following tentative conclusions were drawn: X-bearing sperm and Y-bearing sperm exhibit virtually identical sensitivities to radiation, and sperm with two sex chromosomes are more sensitive than sperm with one sex chromosome which are in turn more sensitive than sperm lacking a sex chromosome. The portion of the proximal heterochromatin lying between the right breakpoints of In(1)sc^4 and In(1)sc^8 or In(1)sc^{S1} has no effect on the sensitivity of X-bearing sperm when it is in its normal proximal position, but when it is shifted to the distal terminus of the X chromosome, as it is by In(1)sc^8 or In(1)sc^{S1}, it causes an increase in the sensitivity of the X-bearing sperm. Closing the X chromosome, i.e. using a ring-shaped X, causes a large increase in the sensitivity of X-bearing sperm. (Auth.)

1008 Nelson-Rees, W.A. NEW OBSERVATIONS ON LECANOID SPERMATOGENESIS IN THE MEALY BUG, Planococcus citri. Chromosoma 14 (1963) 1-17.

In irradiation experiments, young 2nd instar males were placed in gelatine capsules and treated with 1000 r x-rays, at 418 r/min. They were fixed 41 h later. Observations were made by phase microscope during actual cell division, as well as on stained and unstained squash preparations. Examination of the 2nd spermatogenic division of the mealy bug, P. citri (Risso), a lecanoid coccid, has revealed hitherto unknown spindle activity of the euchromatic set of chromosomes during anaphase II. An initial large half spindle elaborated by the hetero-chromatic chromosomes in early metaphase, gives way to a less pronounced, but clearly visible bipolar spindle involving both sets of chromosomes at early anaphase. There is no lengthening of the spindle or cell, but the separation of the chromosomes occurs around the periphery of the cell with the aid of interzonal activity. The activity participation of the euchromatic chromosome during the separation is furthermore inferred by the formation of bridges resulting from euchromatic-hetero-chromatic translocations. (Auth.)

1009 Oster, I.I., Pooley, E. METHODS FOR ESTIMATING DIFFERENTIAL RADIOSENSITIVITY. (Abstr. 5.37) p.67-8 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September, 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

A combination of different techniques has permitted cytogenetical analyses of cells representing homogeneous stages of development at the time of treatment. These methods include the use of our so-called multi-purpose stocks (i.e. strains which allow for the detection of several different types of genetical damage in the offspring of the same treated individual), histological examination of the germ tract of the treated individuals, and a sampling technique that involves the treatment of immature stages which contain a preponderance of germ cells in a similar stage of development. The clear-cut pattern of germ cell radiosensitivity as regards various types of genetical damage which has emerged for Drosophila is in general agreement with that obtained more recently for the mouse by Dr. L.B. Russell. This parallelism suggests that the mechanism(s) underlying differential radiosensitivity may be quite widespread. In addition to a comprehensive report of the results obtained with radiation, comparisons are made with the data obtained by treating the reproductive cells with chemical mutagens. (From abstr.)

1010 Parker, D.R. ON THE NATURE OF SENSITIVITY CHANGES IN OÖCYTES OF Drosophila melanogaster. p.11-19 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Changes in sensitivity in stages 7 and 14 of primary oöcytes of Drosophila were studied with special attention on detachments of attached X chromosomes and the induction of dominant and recessive lethals. Changes in sensitivity between stages 7 and 14 are not simple. In the case of rearrangement, the increase involves a disproportionate increase in the value of k, and the total increase is underestimated due to the greater proportion of inviable aneuploids occurring in the later stage. The increase in sensitivity is accompanied by much less rapid rejoining, and this may be the principal basis for the increase in the value of k, through a lowering of the probability of restitution. In the case of dominant lethals, there is a change in the mode of their production, it being a two-hit process in the early stage, becoming one-hit later. The delay in rejoining may be the primary cause, dominant lethals in stage 14 arising from breaks that do not restitute or rejoin. The increase in frequency of recessive lethals seems primarily dependent on the increased frequency of two-hit events, hence may be due to an increased production of chromosomal aberrations, perhaps small deficiencies. (NSA 18:1964, 11829)

1011 Rai, K.S. X-RAY-INDUCED MITOTIC CHANGES AND MORTALITY IN Aedes aegypti LINN. (Abstr.) Genetics 47, 8 (1962) 977.

See 1013.

1012 Rai, K.S. RADIOSENSITIVITY OF THE MITOTIC CYCLE OF Aedes aegypti. (Abstr. 206) Bull. ent. Soc. Amer. 8, 3 (1962) 162.

Following exposure to x-rays, the number of dividing cells in whole brains of Aedes aegypti larvae was scored. Initially, all doses suppressed mitotic activity almost completely. Later, there was a great increase in cell division, the rate at 500 and 1000 r being more than double the rate in untreated controls.

1013 Rai, K.S. A CYTOGENETIC STUDY OF THE EFFECTS OF X IRRADIATION ON Aedes aegypti. Caryologia 16 (1963) 595-607.

Cytogenetic effects of x-rays (500, 1000, 2000, 4000 r) on the NIH strain of Aedes aegypti L. were studied. Larvae were reared under controlled conditions and were irradiated 6 d after hatching, at a time when most were in the early 4th instar. 5-10 larvae were fixed for cytological examination at intervals of 0, $1\frac{1}{2}$, 6, 12, 18, 36, and 72 h after irradiation. Mitotic chromosomes were studied from squash preparations of larval brains stained with acetolactic orcein. Mitotic activity was measured in terms of the total number of dividing cells per brain. Initially, x-irradiation inhibited cell division. Mitotic activity was almost completely suppressed $1\frac{1}{2}$ h after irradiation. After a time (depending on dose used), this effect was replaced by a great increase in mitotic activity. Twelve hours after irradiation, the larvae exposed to 500 and 1000 r showed about twice as many mitotic figures as did the unirradiated material. The increase in mitotic activity at higher doses was less extreme and took longer to occur. Among the chromosomal aberrations noted were deletions, inversions, exchanges, rings, decentrics and anaphase bridges. Explanations for the induction of these aberrations were discussed. A relation existed between the dose received and the developmental stage at which an individual died. The higher the dose, the earlier the death occurred. Furthermore, 2000 r or more resulted in almost 100% mortality. Some possible causes of x-ray-induced mortality and changes in fertility were suggested. (Auth.)

1014 Ratty, R.J. A COMPARISON OF MUTATION RATES IN MALE AND FEMALE PRE- AND POSTMEIOTIC GERM CELLS OF Drosophila. (Abstr.) Genetics 46, 8 (1961) 891-2.

This study has attempted to determine whether the mutation rates of the yellow (y), white (w), split (spl), and forked (f) loci contained in the white-mottled-4 (w^{m4}) chromosomes are comparable in male and female germ cells. The work reported herein is based upon the examination of 244 106 F_1 of both sexes derived from irradiated w^{m4} males and 172 000 F_1 of both sexes derived from irradiated w^{m4} females. White-mottled-4 parents were mated to y w spl f flies following exposure to 3000 r and the progeny were scored for the occurrence of viable and lethal mutations. The parents were subcultured to new media every three days for a maximum of 24 d. A comparison of the mutation rates indicates an excess of y, w and w-N mutants in ova whereas more $N(w^+)$ mutants were found in sperm. A comparable number of f mutants was found among the progeny of irradiated males and females. In the period 4-12 d after irradiation, an excess of all types of mutations was found in spermatocytes. However, subsequent to this period no mutants were found following the examination of 35 873 females derived from irradiated males, whereas 10 y, one w, one w-N and 10 f mutants were recovered from a comparable number of progeny of irradiated w^{m4} females up to 24 d subsequent to the time of irradiation. It would appear that both viable and lethal mutations are either produced more readily in premeiotic female than male germ cells or they are transmitted with greater facility.

1015* Sado, T. HISTOLOGICAL STUDIES OF RADIATION SENSITIVITY OF SPERMATOGENIC CELLS OF THE SILKWORM (Preliminary note). Genetics, Japan 9 (1958) 101-2.

1016 Sado, T. SPERMATOGENESIS OF THE SILKWORM AND ITS BEARING ON THE RADIATION INDUCED STERILITY. p.136-50 in "Proceedings of the Symposium on Genetic Effect of Radiation, Mishima, 7-8 November 1960". Jap. J. Genet. 36, Suppl. The Genetics Society of Japan. 1961. (In English).

The correlation between the developmental stages of larvae and the germ cell stages in the testis was investigated in order to obtain basic knowledge required for mutagenesis work with the silkworm. The duration of each stage in spermatogenesis of the silkworm was estimated from the time table of the 1st appearance of cells in successive stages. It was noted that meiotic prophase takes about 10 d but late meiotic stages proceed within a short time. Results of the histological examinations of irradiated testes of the silkworm were in good agreement with those of previous workers on different animals, showing an extreme sensitivity of secondary spermatogonia to the killing effect of x-rays. Spermatocytes at late meiotic stages were shown to be more sensitive to irradiation than those at synaptic and pachytene stages. In the silkworm sterility due to the destruction of late spermatogonia is not detectable, even though the cells are easily killed by radiation. Pronounced sterility after irradiation in the early 5th instar occurs as a result of damage to late meiotic stages, expecially in late prophase. These findings have been discussed in relation to similar ones in mice and Drosophila, and it has been shown that a consistent picture of radiation induced sterility in animals can be inferred.

1017* Sävhagen, R. THE RELATION BETWEEN THE RATE OF INDUCED TRANSLOCATIONS AND TREATED CELL STAGES IN MALES OF Drosophila melanogaster. Hereditas 46 (1960) 651-67.

The present paper deals with the relation between induced translocations and the treated cell stages in Drosophila males. By use of a dual-purpose stock it was possible to study the frequency of induced XXO females in F_1 and the rate of induced translocations in F_2. The observed frequency of induced XXO females parallels very well earlier studies with induced XO males and induced non-disjunction between the paternal X and Y chromosomes. The occurrence of non-disjunction females was used as an indication of cells treated prior to anaphase I. It was shown that the frequency of induced translocations varies with the mating periods, which, according to the brood technique, represent successively younger germ cells. The peak of translocations was observed on the 6th day after irradiation. It is suggested that the cells which become available for insemination during this mating period chiefly correspond to cells treated as early spermatids. Germ cells irradiated during early meiosis (prior to anaphase I) yield few translocations (8th day after treatment). The reduction in the rate of induced translocations is even more pronounced on the 10th or 14th day after irradiation. It is evident that there exists a difference in the observed pattern of sensitivity to irradiation when different types of aberrations are used as an indication of induced genetic damage. No effect is observed upon the rate of induced translocations when the dose is delivered in two fractions with an interval of 1 h. Thus an interval of 1 h was not long enough to allow rejoining of chromosome breaks giving rise to translocations. (Auth.)

1018 Sävhagen, R. THE RELATION BETWEEN X-RAY SENSITIVITY AND STAGES OF DEVELOPMENT OF TREATED CELLS IN SPERMATO- AND SPERMIOGENESIS OF *Drosophila melanogaster*. *Hereditas 47* (1961) 43-68.

By using a dual-purpose stock it was possible to study the frequency of induced XO males and induced non-disjunction between the paternal X and Y chromosomes in *Drosophila* after 0 to 1 and 3 to 4-d-old y^{16}; sc^8 Y males were irradiated (1100 r) and mated to virgin y w sn females in successive mating periods. The first mating period was delimited to 0 to 4 h after irradiation but from the 4th day and on each mating period consisted of 24 h. It is shown that irradiation of *Drosophila* males causes non-disjunction between the paternal X and Y chromosomes. Hence, the occurrence of an increase in the frequency of non-disjunction in sperm ejaculated during a limited period after irradiation must be taken as an indication that those spermatozoa were in meiosis at the time of treatment. Factors which may influence this cell stage/ sensitivity relationship are discussed. (Auth.)

1019 Sävhagen, R. CELL STAGES AND DIFFERENTIAL SENSITIVITY TO IRRADIATION IN MALES OF *Drosophila melanogaster*. p.343-57 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

By simultaneous studies of paternal non-disjunction and a certain type of chromosome aberration in *Drosophila* the brood pattern was correlated with the early meiotic stages in spermatogenesis, prior to anaphase I. It was shown that the cells treated in meiosis became available for insemination during the 7-10th day after irradiation. The peak of sensitivity to irradiation measured through induced XO males of XXO females, coincides with the peak of induced paternal non-disjunction and thus with cells treated in early meiosis. About the same sensitivity pattern is obtained after irradiation of 0-1 and 3-4-d-old males. There is, however, a difference in the amplitude of sensitivity. Thus the frequency of both XO males and induced non-disjunction females is much lower in experiments with 3-4-d-old males. When comparing the different methods used in order to demonstrate the genetic effects (damage) of irradiation it is evident that there is not only a marked difference in sensitivity to irradiation between various stages of spermatogenesis in *Drosophila*, but also a difference in sensitivity pattern depending on the type of aberration studied. Hence the differences in the sensitivity patterns reflect the relationship between the mechanisms at work in producing different kinds of damage and the cell stage treated. The relationship between induced genetic changes and oxygen concentration in various stages of spermato- and spermiogenesis was studied. The effect after irradiation in nitrogen atmosphere reveals that anoxia exerts the most striking influence upon the yield of XO males during the period of highest sensitivity to x-irradiation. Irradiation in commercial oxygen affects the sensitive stages in different ways in 0-1 and 3-4-d-old males. In the younger males there is a lower effect than that obtained after irradiation in air, while in 3-4-d-old males there is a correspondingly higher rate of chromosome losses. (Auth.)

1020 Schmid, W. DIFFERENTIAL SUSCEPTIBILITY OF SPERM AND SPERMATIDS TO IONIZING RADIATIONS. *Amer. Nat. 95* (1961) 103-11.

A hypothesis is offered to explain the differential susceptibility of sperm and spermatids to ionizing radiations. In *Drosophila*, a given x-ray dose causes up to several times more genetic mutations in spermatids than in sperm. Further, the two kinds of cells show different dose-effect curves, react differently to changes in the oxygen tension during x-irradiation, but behave very similarly to neutron irradiation. In sperm the condensed chromosomes are packed tightly together in the small sperm heads, while the chromosomes of spermatids, located in regular nuclei, are separated from each other by some space within the caryolymph. The proposed hypothesis assumes that the diffusing secondary radiochemical products of ionizations occurring in the immediate neighbourhood of the chromosomes cause a considerable amount of chromosomal damage, in addition to the effects due to ionizations occurring within the structures of the chromosomes themselves. The additional space is present around the chromosomes of spermatids as in most other types of cells but is practically missing in the exceptional cell-type represented by sperm. Various differences in the reaction of spermatids and sperm may thus be explained. (From auth. summary)

1021 Slizynska, H. HETEROGENEITY AMONG SPERMATOGONIA OF *Drosophila melanogaster* IN SENSITIVITY TO X-RAYS. *Genet. Res. 4* (1963) 446-56.

Sensitivity of *D. melanogaster* male germ-cells to chromosome breakage by x-rays was measured by the structural changes found in the salivary gland chromosomes of larvae from irradiated fathers and untreated mothers. The genetical effectiveness of irradiation on the same males was measured by the frequency of sex-linked lethals. Assessed by the overall percentage of germ-cells carrying structural changes, sensitivity follows the well-known pattern: it is highest in spermatids and decreases over spermatozoa and spermatocytes to spermatogonia. This overall sensitivity was analyzed on three levels. The fact that the sensitivity of spermatogonia varies both between and within individual males was tentatively attributed to the presence or absence of spermatogonial mitoses. (Auth.)

1022 Strangio, V.A. RADIOSENSITIVE STAGES IN THE SPERMATOGENESIS OF *Drosophila melanogaster*. *Nature, Lond. 192* (1961) 781-2.

A preliminary account is given of experiments designed to detect simultaneously complete loss of X or Y chromosomes, deletion in the Y chromosome, and non-disjunction between X and Y chromosomes. A new, doubly marked Y chromosome stock designated $sc^8 YB^S$ is used. After x-irradiation with 1000 r, males with a wild-type X chromosome and the doubly marked Y are mated daily to 3 females homozygous for the X chromosome markers yellow, apricot, echinus. On the assumption that the determination of non-disjunction will occur only at or before anaphase in the first meiotic division, the results indicate that the 7th brood in particular represents treated pre-meiotic stages and confirm the high sensitivity of meiotic and immediately pre-meiotic stages to the mutagenic effect of x-rays. (NSA 16: 1962, 2911)

1023 Strangio, V.A. RADIOSENSITIVITY DURING SPERMATOGENESIS IN *Drosophila melanogaster*. *Amer. Nat. 96*, 888 (1962) 145-50.

Males carrying the dominant Bar (B^S) marker on the Y chromosome are x-rayed (800 r) and then mated afresh to virgin Bar-reverted B^+ asc (modified Muller-5) females on each of the 12 d following irradiation. Assuming that this brood order reflects inversely the sequence and duration of the individual stages in sperm formation, the experimental method permits simultaneous detection of sex-linked recessive lethals, sex chromosome loss and primary non-disjunction of the sex chromosomes induced in male germ cells which were at different points in the maturation cycle at the time of irradiation. If the onset of induced primary non-disjunction is accepted as a criterion of irradiated primary spermatocytes, the results confirm earlier findings that hypersensitivity to the induction of sex-linked recessive lethals occurs in the post-meiotic spermatid stage while peak sensitivity for sex-chromosome loss occurs in spermatocytes. (Auth.)

1024 Tazima, Y. CONSIDERATIONS ON THE CHANGES IN OBSERVED MUTATION RATES IN THE SILKWORM AFTER IRRADIATION OF VARIOUS STAGES OF GAMETOGENESIS. p.50-64 in "Proceedings of the Symposium on Genetic Effect of Radiation, Mishima, 7-8 November 1960". *Jap. J. Genet. 36* Suppl. The Genetics Society of Japan. 1961. (In English),

The criteria employed in the comparison of radiation effects were fertility, fecundity, dominant lethals, and recessive mutations at marked loci with genes that express their action at very early stages of the life cycle. The results are mostly consistent with existing data on *Drosophila* and mouse. However, extreme sterility was observed when germ cells were (x-) irradiated at late meiotic prophase (see effects on late spermatogonia in mice). Two types of dose-rate dependence in radiation-induced mutation rate occurred at different stages of early larval development. The technique used allowed mutants to be detected at very early stages of embryonal development. It appears that gross chromosomal aberrations reduce the detectability of viable mutations in later stages of development. The second peak in mutation frequency occurred around the time of hatching, in both sexes, when almost all germ cells are presumably in the primordial stage. (It should be noted that it is characteristic of *Bombyx mori* that all germ cells develop almost synchronously)

1025 Tazima, Y., Kondo, S. DIFFERENTIAL RADIATION-SENSITIVITY OF GERM CELLS AS A POSSIBLE INTERPRETATION OF SEX DIFFERENCE IN DOSE-RATE DEPENDENCE OF INDUCED MUTATION RATES IN THE SILKWORM. p.237-52 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press, 1963.

In order to elucidate the difference in sex with respect to mutation response of silkworm germ cells, experiments were carried out on silkworms. The dose-mutation frequency relationship was followed up by irradiating spermatogonia and oögonia with acute (316 ~333 r/min) or chronic (0.069 ~0.208 r/min) irradiation at the earliest larval stage. The shape of the dose-frequency curves was different between spermatogonia and oögonia. In oögonia a linear relationship was clearly observed for both acute and chronic irradiation, while in spermatogonia the frequencies for acute and chronic exposures increased with the increase of dose more rapidly than expected for linearity; the dose rate difference becoming smaller in the high dose range. Survival of irradiated germ cells was estimated by analysing theoretically the frequency distribution of the number of recovered mutants per mating pair. Comparison in LD$_{50}$ between spermatogonia and oögonia clearly showed that spermatogonia are twice as sensitive to radiation as oögonia. It was concluded that the dose-rate dependence of radioinduced mutation rate is closely correlated to the killing effect of radiation, and hence to the sensitivity of germ cells. The significance of these phenomena in the process of recovery of primary mutational damage is discussed. (NSA 18; 1964, 11839)

1026 Thompson, P.E. THE EFFECT OF ASYNAPSIS ON MUTABILITY IN THE TESTIS OF Drosophila. (Abstr.) Genetics 46, 8 (1961) 904.

In males of Drosophila, normal chromosomes paired with inverted chromosomes have shown higher rates of spontaneous and x-ray induced mutation than isogenic controls. This difference in mutability is most striking in meiotic stages, where its magnitude after irradiation implies a synergistic interaction of treatment and the genetic constitution. The effect is limited to those chromosomes in which structural heterozygosity exists. – Two alternative hypotheses toward an underlying mechanism of increased mutability have been advanced: an effect of stress or torsion associated with inversion-pairing configurations, and an effect of the partial asynapsis that must accompany structural heterozygosity. A test of the effect of asynapsis without torsion is made possible by the use of SM5, a complex intrachromosomal rearrangement having 13 inversion or transposition breaks, which does not pair appreciably with its homologue. Preliminary results indicate high mutability of the unsynapsed homologue of SM5 and suggest that homologous pairing itself is an important factor in mutation, presumably by some facilitation of repair.

1027 Thompson, P.E. ASYNAPSIS AND MUTABILITY IN Drosophila melanogaster. Genetics 47 (1962) 337-49.

From analysis of salivary gland configurations and patterns of non-disjunction, it is estimated that highly rearranged Second Multiple 5 (SM5) chromosome does not pair extensively with its homologue. The frequency of chromosome II lethal mutations was significantly higher among sperm from asynaptic SM5/+ males (19.5%) than among sperm from control males (8.6%) 6-8 d after treatment with 1000 r of x-rays. These sperm batches are interpreted as having been in or near meiosis at the time of irradiation. This sensitivity of SM5/+ males was found not to extend to the X chromosome after irradiation indicating that such males do not have an inherently high mutability. The rate of spermiogenesis or sperm maturation in SM5/+ males and control males was compared by scoring induced crossovers, fecundity and egg hatchability during single-day mating periods after irradiation. No difference in the pattern of these effects was observed, so that the maturation time of both groups of males is apparently the same. The interpretation that asynapsis is an important factor during meiosis is supported by these findings. It is suggested that during meiosis the synapsis of homologous chromosomes favours the repair of chromosomal disruptions over the formation of rearrangements, and that asynapsis may greatly increase the frequency of lethal mutations. (Auth. summary)

1028 Thompson, P.E. SYNAPTIC MODIFICATION OF DOMINANT LETHAL FREQUENCIES AFTER IRRADIATION OF THE Drosophila TESTIS. (Abstr.) Genetics 47, 8 (1962) 991.

Increases in the mutability of unpaired chromosomes have led to the interpretation that the synapsis of homologous chromosomes is a major factor in the repair of radiation induced chromosomal damage. This hypothesis is substantiated by the present data on the production of dominant lethals among males in which complex structural heterozygosity (presence of multiple inversion SM5) has created almost total asynapsis of one major pair of chromosomes. Egg development among 1-d broods from such males after x-ray treatment gave evidence of an appreciable increase in dominant lethals of meiotic origin, in comparison with males lacking structural heterozygosity. The brood pattern of dominant lethals from irradiated control males shows a plateau of maximum frequency from early meiosis to spermatid stages, i.e., among sperm sampled from the 5th to the 8th day after irradiation. Broods from irradiated SM5 males gave similar frequencies for premeiotic and postmeiotic stages, including the 5th and 10th brood periods, but during days 6-8 about twice as many dominant lethals were scored among these lines. If dominant lethals may be equated with highly aberrant rearrangement or loss of chromosome fragments, asynapsis appears to contribute markedly to gross genetic damage during meiosis.

1029 Whiting, A.R. A COMPARISON OF VISIBLE MUTATION RATES IN Habrobracon EGGS X-RAYED IN FIRST MEIOTIC METAPHASE OR PROPHASE. (Abstr.) p.117 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The extreme difference in sensitivity to x-rays of Habrobracon eggs irradiated in first meiotic metaphase or prophase as measured by dominant and recessive lethal mutations has been established by studies previously published. This difference has now been found to apply to visible mutations as well. Two methods of testing were used: (a) the same dose, 1100 r, for both stages and (b) 1100 r for metaphase and 25 000 r for prophase, doses giving comparable lethal rates. After 1100 r, for eggs exposed in metaphase, percentage of visible mutations was 5.35, for those exposed in prophase, 0.48. After 25 000 r, percentage was 6.18 for prophase. Difference between 1st and 2nd percentages is significant, between 1st and 3rd, not significant.

1030 Würgler, F.E., Ulrich, H., Schneider-Minder, A. VARIATION OF RADIOSENSITIVITY DURING MEIOSIS AND EARLY CLEAVAGE IN NEWLY LAID EGGS OF Drosophila melanogaster. p.101-4 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press, 1963.

In one set of experiments eggs were irradiated (500 r of 50 keV x-rays) at different ages, having been maintained at 24.4°C from oviposition until completion of irradiation. Variations of x-ray induced embryonic mortality during meiosis and early cleavage in Drosophila eggs are shown in a graph. Peaks of radiosensitivity (high embryonic mortality) were obtained in late anaphase/early telophase of meiosis II of every cleavage division so far analysed. The relatively lowest radiosensitivity occurred in the pronucleus and in the interphase stages. (A very similar pattern of sensitivity has been reported by von Borstel (same symposium) for Habrobracon)). Two groups of easily distinguishable lethal syndromes are (1) early death = death before gastrulation, and (2) late death = death after gastrulation but before hatching of larvae. Dose-action curves were recorded at every stage during the first 1/2 h of development. The curve for early death has an initial slope followed by a flattening off and a further increase at higher doses. In exactly the same region in which the flattening off was found the late death curve shows a steep increase. Total embryonic mortality (the sum of the 2 curves) is therefore the superposition of dose-action curves for different syndromes of lethality. Interpretation of the early-death curves is attempted.

See also:

757 Dependence of the frequency of occurrence of dominant lethal mutations in the spermatids of Drosophila upon dose of irradiation with fast neutrons. (Abeleva and Lapkin, 1963)

758 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1959)

759-60 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1960, 1961)

764 Effects of x-rays on female germ-cells of Drosophila melanogaster. I. Dominant lethal mutation and oviposition in relation to treated stage. (Bateman and Chandley, 1963)

770 The induction of mutations in spermatocytes of Drosophila melanogaster with x-rays. (Chandley, 1962)

771 Developmental-genetic study of the effect of x-ray irradiation in Drosophila virilis and Bufo valliceps. (Clayton, 1961)

785 The response of Drosophila testis to x-ray induction of dominant lethals. (Hoenigsberg et al., 1961)

800 Induction of mutations and cell killing in irradiated Drosophila spermatogonia. (Oftedal, 1963)

802 Induction of mutations and killing of cells in irradiated spermatogonia of Drosophila. (Oftedal, 1963)

814 Studies on the genetic effect of radiation 1959-1960. II. Studies on the genetic effect of radiation with silkworm. (1) Differences between times of death of the F$_1$ after irradiation of oögonia or mature oöcytes. (Tazima and Onimaru, 1962)

816 X-ray induced "dominant lethals" in inseminated eggs of Drosophila. (a) Experiments in the stage between completion of meiosis and beginning of cleavage. (Ulrich, 1963)

820 X-ray induced "dominant lethals" in inseminated eggs of Drosophila. (b) Experiments with different stages between insemination and end of second cleavage division. (Würgler, 1963)

826 The relatively high frequency of whole-body mutations compared with fractionals induced by X-rays in Drosophila sperm. (Altenburg and Browning, 1961)

838 X-ray induced sex-linked recessive lethals and visibles in Sciara (i.e. Bradysia) coprophila. (Crouse, 1961)

851 Structure of "yellow" mutations induced by x-rays of scute^8 chromosomes of different germ cells in Drosophila melanogaster. (Frye, 1961)

859 The effect of small doses of ionizing radiation on the frequency of occurrence of sex-linked, recessive, lethal mutations of *Drosophila*. (Glembotskiĭ *et al.*, 1963)

868 The rates of visible mutations in sequential broods of irradiated *Drosophila melanogaster* males. (Hannah-Alava, 1963)

869 Embryonic lethals induced by x-irradiation of first meiotic metaphase oöcytes of *Habrobracon*. (Heidenthal, 1962)

912 X-ray induced visible mutations in *Habrobracon* oöcytes. (Whiting, 1963)

918 Chromosome rearrangements induced by x-rays in immature germ cells of *Drosophila*. (Abrahamson, 1961)

961 Analysis of irradiated *Drosophila* populations for meiotic drive. (Novitski and Hanks, 1961)

970 Induction of chromosome aberrations in the spermatocytes of grasshopper. (Ray-Chaudhuri, 1961)

972 The relationship between type of aberration and sensitivity pattern in irradiated *Drosophila melanogaster* males. (Sävhagen, 1961)

1033 Chemical effects on x-ray induced mutation processes in *Drosophila*. (Sobels, 1961)

1034 Dependence of the frequency of occurrence of recessive sex-linked lethal mutations in *Drosophila* spermatogenesis on the fast-neutron dose. (Abeleva, and Lapkin, 1963)

1035 Further studies on the influence of oxygen on x-ray-induced rearrangement in *Drosophila* oöcytes. (Abrahamson, 1961/62)

1036 The relationship of radiations and environmental changes in oxygen concentration for biological damage in the immature germ cells of *Drosophila virilis*. (Alexander, 1958)

1037 The effects of radiation on the genetic system of organisms in relation to their physiological and biochemical systems. (Alexander, 1958)

1040 The response of pre-meiotic and post-meiotic germ cells of *Drosophila* to dose fractionation and changes in partial pressures of gases. (Alexander, 1962)

1041 Oxygen effects and dose fractionation in the developing germ cells of *Drosophila virilis*. (Alexander, 1963)

1054 The effects of chloramphenicol,streptomycin and penicillin on the induction of mutations by x-rays in *Drosophila melanogaster*. (Clark, 1963)

1065 The oxygen effect in irradiated mature and meiotic germ cells of *Drosophila melanogaster*. (Hoenigsberg *et al.*, 1961)

1074 Post-irradiative effects of nitrogen and carbon monoxide on hatchability of *Habrobracon* eggs treated in first meiotic metaphase. (LaChance, 1961/62)

1081 Effects of radiations on cell division and chromosomes in animals. Final Report No. 2, 15 Dec. 1961-14 Dec. 1962. (Makino, 1962)

1087 Differential yields of mutations from the first and second matings after irradiation of mature sperm in *Drosophila melanogaster*. (Mossige, 1963)

1100 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)

1107 The effect of x-ray treatment combined with air, nitrogen, or oxygen in *Drosophila melanogaster* studied on sex-linked recessive lethals. (Pozzi *et al.*, 1962)

1108 Differential sensitivity of spermatogenic stages of *Drosophila melanogaster* to x-ray irradiation in O_2 and N_2. (Pozzi *et al.*, 1962)

1110 Dose-rate and the induction of mutation in *Drosophila*. (Purdom and McSheehy, 1963)

1112 The effect of intensity and fractionation on radiation-induced mutation in *Drosophila*. (Purdom, 1963)

1113 Protective action of Versene against radiation damage to grasshopper chromosomes. (Ray-Chaudhuri and Saha, 1960)

1114 Cysteamine protection of grasshopper chromosomes from x-ray-induced aberrations under aerobic and anaerobic conditions. (Ray-Chaudhuri *et al.*, 1962)

1115 The genetical response of radiation spermatozoa to different types of radiation treatment. (Reddi, 1963)

1121 The frequency of XO males and induced autosomal crossovers after irradiation of *Drosophila melanogaster* males in air or commercial nitrogen. (Sävhagen, 1961)

1123 The effect of carbon monoxide as a respiratory inhibitor on the production of dominant lethal mutations by x-rays in *Drosophila*. (Schmid, 1961)

1127 Recovery from premutational damage of x-irradiation in *Drosophila* spermatogenesis. (Sobels and Tates, 1961)

1128 The role of oxygen in radiosensitization by cyanide in *Drosophila*. (Sobels, 1961)

1129 Modifications of the mutagenic effect of x-irradiation in *Drosophila* males by chloramphenicol and ribonuclease. (Sobels, 1962)

1130 Dose rate, cyanide, and some other factors influencing repair of mutational radiation damage in *Drosophila*. (Sobels, 1962)

1131 Modification of pre-mutational radiation damage in *Drosophila*. (Sobels, 1962)

1133 Experiments on repair of pre-mutational radiation damage in *Drosophila*. (Sobels, and Tates, 1963)

1134 The contrasting effects of oxygen and nitrogen in determining initial sensitivity and postradiation recovery in *Drosophila* sperm and spermatids. (Sobels, 1963)

1136 Repair and differential radiosensitivity in developing germ cells of *Drosophila* males. (Sobels, 1963)

1141 Modification of genetic radiation damage in *Drosophila* by post-treatment with nitrogen and fractionation of the dose. (Tates and Sobels, 1961)

1150 Dose-dependence of radiation-induced mutation rate in *Drosophila melanogaster* depending on the stage sensitivity of the irradiated germ cells. (Traut, 1962)

1151 A study of dose-dependence of radiation-induced mutation rates in *Drosophila melanogaster*, allowing for the degree of maturity of the germ cells. (Traut, 1962)

1152 Dose dependence of the frequency of radiation induced recessive sex-linked lethals in *Drosophila melanogaster*. (Traut, 1963)

1153 Dose-dependence of the frequency of radiation-induced recessive sex-linked lethals in *Drosophila melanogaster*, with special consideration of the stage sensitivity of the irradiated germ cells.

1161 Temperature effects on lethal mutation rates of *Habrobracon* oöcytes x-irradiated in first meiotic metaphase.

1163 The effect of roentgen rays and of high temperature upon the crossing over process. (Zakharov and Inge-Vechtomov, 1963)

1162 The influence of oxygen on the frequency of radiation-induced chromosome aberrations in oöcytes of *Drosophila melanogaster*. (Wind and Traut, 1961)

1165 Cell killing and the problem of nuclear reactivation. (Borstel and Löbbecke, 1962)

1173 Cytogenetic investigations on the nature of dominant lethals induced in meiotic oöcytes by gamma radiation and alkylating agents. (LaChance and Riemann, 1963)

1175 Mutational response of *Habrobracon* oöcytes in metaphase and prophase to ethyl methanesulfonate and nitrogen mustard. (Löbbecke and Borstel, 1962)

1189 Cytological evaluation of differential radiosensitivity in spermatogenous cells of *Drosophila*. (Kaufmann and Gay, 1963)

1190 Radiation effects on the cytoplasm of *Habrobracon* eggs. (Kenworthy, 1962)

1194 A quantitative study of chromosomal elasticity and its influence on chromosome movement. (Nicklas, 1963)

1195 Studies on the normal and x-irradiated spermatogenesis of *Stenobothrus viridulus* and *Schistocerca gregaria* (Orthoptera). (Mathur, 1960)

1196 The effect of x-radiation on the spermatogenesis of *Petrobius maritimus*. (Mathur, 1961)

1197 Cytochemistry of the normal and x-irradiated spermatogenesis of *Stenobothrus viridulus* (Fischer). (Mathur, 1963)

1200 The influence of x-rays on organelle induction and differentiation in grasshopper spermatogenesis. (Tahmisian and Devine, 1961)

1201 Cytological effects. (Tahmisian, 1961)

1222 Effects of radiations on insects. (LaChance, 1962)

1264 Radiosensitivity of developing reproductive cells in female *Cochliomyia hominivorax*. (LaChance and Leverich, 1962)

1287 Fecundity studies on x-rayed *Mormoniella vitripennis*. (Ray, 1963)

1290 Investigations on the spermatogenesis and embryonic development following irradiation of *Calliphora erythrocephala* Meig., Diptera, Calliph., males. (Taege, 1963)

I-A-6 MODIFYING FACTORS
(INTENSITY. PLOIDY. RBE. LET. TEMPERATURE. SYNERGISTS. CHEMICALS INCLUDING PROTECTIVE AGENTS. ENVIRONMENT AT IRRADIATION. Etc.)

General

1031 Clark, A.M. MODIFICATION OF GENETIC RESPONSE TO X-IRRADIATION IN *Drosophila*. p.216-28 in "Radiobiology. Proceedings of 3rd Australasian Conference on Radiobiology, Sydney, 15-18 August 1960". Ilbery, P.L.T., Ed., London, Butterworths. 1961.

Modification may be achieved by varying the physical conditions of irradiation (nature of radiation, dose and dose rate, temperature), by altering the chemical conditions (varying degrees of anaerobiosis, the use of metabolic inhibitors before, during or after irradiation) or by changing the physiological state of the material irradiated. The main topic considered in the review is whether, in Drosophila spermatozoa, modification in genetic response to x-irradiation may be obtained by varying the dose rate. The evident complexity of factors which must be taken into account in interpreting data is discussed. Relevant findings published variously between 1954 and 1960 are reviewed critically.

1032 Herskowitz, I.H. AN INFLUENCE OF MATERNAL NUTRITION UPON THE GROSS CHROMOSOMAL MUTATION FREQUENCY RECOVERED FROM X-RAYED SPERM OF Drosophila melanogaster. Genetics 48, 5 (1963) 703-10.

Undernourishment of females before, or before and after they were mated and x-rayed with about 3500 r significantly increased the rate of 2-3 reciprocal translocations recovered from the irradiated sperm chromosomes, as compared with the rate recovered from continuously well fed, otherwise comparable females. The rate of such paternal mutations increased (as much as 50%) in eggs successively oviposited by females that were undernourished before they were mated and irradiated. The rate of complete or certain partial losses of a paternal sex chromosome (rod Y or rod X, or ring X or rod X) increased about 300 to 600% in eggs successfully oviposited by females which were undernourished before and after they were mated and x-rayed with about 3500 r. It is hypothesised that mutational enhancement by undernourishment is associated with some effect upon the joining of chromosome ends produced by breakage. (From auth. summary)

1033 Sobels, F.H. CHEMISCHE BEEINFLUSSUNG DES RÖNTGENINDUZIERTEN MUTATIONSPROZESSES BEI Drosophila. (Chemical effects on x-ray induced mutation processes in Drosophila.) Naturwissenschaften 48, 6 (1961) 146-55. (In German)

A review, with 53 references. Pre-treatment with cyanide, formaldehyde or dihydroxydimethylperoxide was found to increase the x-ray induced mutation rate, more markedly in spermatids than in mature spermatozoa. The cyanide effect is probably due to an increase in O_2. Post-treatment with cyanide increased the mutation rate in spermatids provided they had been exposed to a high dose rate, whether in O_2 or in N_2 atmospheres. Increased translocation rates in spermatids occurred independently of the dose rate. Cyanide post-treatment increased the rate of lethal mutations even when a ring chromosome had been treated. Possible interpretations are discussed.

1034 Абелева, Э.А., Лапкин, Ю.А. ЗАВИСИМОСТЬ ОТ ДОЗЫ БЫСТРЫХ НЕЙТРОНОВ ЧАСТОТЫ ВОЗНИКНОВЕНИЯ РЕЦЕССИВНЫХ СЦЕПЛЕННЫХ С ПОЛОМ ЛЕТАЛЬНЫХ МУТАЦИЙ В СПЕРМИОГЕНЕЗЕ ДРОЗОФИЛЫ. Радиобиология 3, 3 (1963) 420-1.

Abeleva, E.A., Lapkin, Yu.A. DEPENDENCE OF THE FREQUENCY OF OCCURRENCE OF RECESSIVE SEX-LINKED LETHAL MUTATIONS IN Drosophila SPERMATOGENESIS ON THE FAST-NEUTRON DOSE. Radiobiologiya 3, 3 (1963) 420-1.

Experiments carried out to clarify the fast-neutron-dose dependence of the occurrence frequency of dominant lethal mutations were inconclusive. The difference between the frequencies in spermatids and sperm with neutron irradiation was less than in γ- and x-irradiation. The dependence on dose in the range 1200-2400 rad tapered off, as in γ-irradiation, but the absolute frequency was so high that it was explained by the reaching of the limits of possible occurrence of the given type of mutation. To determine if hidden factors are involved or if the nature of the mutations caused by fast neutrons in spermatids is similar to that in low-ionizing radiation, the recessive sex-linked lethal mutations were studied, which are less frequent than the dominant. Comparison of the data obtained with earlier data showed that the ratios between the frequencies of mutation in spermatids and sperm in neutron-irradiation at 1000 rad are the same for 1000-r γ-radiation, that is, 2.27 and 2.16, respectively. In the 1000- to 2000-r range the frequency of mutation occurrence was proportional to the 0.57 power of the dose with γ-irradiation and to the 0.37 power with neutron irradiation. (NSA 17:1963, 31936)

1035 Abrahamson, S. FURTHER STUDIES ON THE INFLUENCE OF OXYGEN ON X-RAY-INDUCED REARRANGEMENT IN Drosophila OÖCYTES. Int. J. Rad. Biol. 4, 2 (1961/62) 113-25.

Alteration of the metabolism of Drosophila oöcytes greatly affects the induction of structural changes by x-rays. Females 2-3 d of age contain oöcytes whose chromosomes restitute and rearrange rapidly, whereas no evidence for restitution within the intervals studied was found in samples of oöcytes from females 8-9 d old at the time of irradiation. The effect of nitrogen as a post- or inter-treatment showed, however, that for both young and old oöcytes there was more restitution in air than in nitrogen. Both young and old oöcytes show reduced rearrangement frequencies when irradiations were performed in nitrogen, and increased rearrangement frequencies when a fractionated irradiation was performed with the flies maintained in a N_2 environment between irradiations. These different effects of anoxia are discussed. (Auth.)

1036* Alexander, M.L. THE RELATIONSHIP OF RADIATIONS AND ENVIRONMENTAL CHANGES IN OXYGEN CONCENTRATION FOR BIOLOGICAL DAMAGE IN THE IMMATURE GERM CELLS OF Drosophila virilis. p.3-4 in "Proceedings of 10th International Congress of Genetics, McGill University, Montreal, 20-27 August 1958. Vol.II". Toronto, University of Toronto Press. 1958.

Lethal damage in meiotic and spermatogonial cells was found to be influenced by increased O_2 concentrations with both x-ray and fast neutrons. Differences in lethal damage induced in spermatids by γ-rays in pure oxygen were obtained by varying radiation dose rates. Biological damage induced by x-and γ-rays and fast neutrons was consistently higher in spermatids than in mature sperm when O_2 was present at the time of treatment. A slight but definite enhancement was also obtained with oxygen with fast neutrons in various types of immature germ cells. (NSA 16:1962, 23470)

1037* Alexander, M.L. THE EFFECTS OF RADIATION ON THE GENETIC SYSTEM OF ORGANISMS IN RELATION TO THEIR PHYSIOLOGICAL AND BIOCHEMICAL SYSTEMS. Progress Report, May 1, 1957 - April 30, 1958. TID-17000, Texas. Univ., Houston. M.D. Anderson Hospital and Tumor Inst. 17p.

The effects of radiation on the genetic system of organisms in relation to their physiological and biochemical systems were investigated in the immature germ cells of Drosophila virilis. This biological system offers a group of cells composed of spermatogonial cells, meiotic cells, and post-meiotic spermatid and sperm cells. Different amounts and types of biological damage were observed in the different types of cells. Results are presented on the effects of fast neutrons, 200 kV x-rays, 1.17- to 1.33 MeV γ-rays from a Co^{60} source, and 22-MeV x-rays from a betatron source. The RBE values for the radiations used were calculated using the rad dose necessary to produce lethals in 50 % of cells. Data are tabulated. (NSA 16:1962, 1236)

1038 Alexander, M.L., Bergendahl, J. BIOLOGICAL DAMAGE IN THE MATURE SPERM OF Drosophila virilis IN OXYGEN AND NITROGEN WITH DIFFERENT DOSE INTENSITIES OF GAMMA RAYS. Genetics 47 (1962) 71-84.

Modifications in the percentages of dominant lethal and translocation damage were not obtained by varying the dose rate of γ-rays in treatments of mature sperm of D. virilis. Nineteen experiments in 5 series of tests were performed using radiation dose rates from 50 r/min to 2000 r/min or 2 fractionated doses divided by periods from 15 to 60 min. The dose rates of γ-rays did not modify the amount of 2 break, reattachment types of chromosome damage, translocations, or dominant lethal damage when treatments were made in either a completely oxygen-saturated atmosphere or an anoxic atmosphere of N_2. Post-irradiation recovery periods were not detected by testing with alternate radiation treatments in O_2 and N_2. Different time intervals of 15 to 40 min between treatments failed to produce modifications in the percentages of dominant lethals. Therefore, there is no indication of a post-irradiation time limit for recovery mechanisms in Drosophila sperm. The possibility of genetic "repair" mechanisms operating after chronic irradiation of spermatogonial cells and of post-irradiation effects in metabolically active cells are discussed briefly. (From auth. summary)

1039 Bicker, A.E. RELATIVE EFFECTIVENESS OF 14 MeV NEUTRONS AND 200 kVp X-RAYS FOR PRODUCTION OF LETHALITY IN GRASSHOPPER EMBRYOS. A preliminary study. Thesis. TID-15962, Kansas. Univ., Lawrence. May 1962. 52p.

A test system using the grasshopper embryo (Chortophaga viridifasciata (deGeer), and Encoptolophus sordidus (Burmeister)) with hatching as the criterion for the end point is proposed to determine the RBE. Eggs of Chortophaga (14-d) and Encoptolophus (14-d and terminal) were subjected to various doses of 200 kVp x-rays, and eggs of Chortophaga to various doses of neutrons. X-ray median lethal doses were estimated (650 rads for Chortophaga (14-d), 760 rads and 1800 rads for Encoptolophus, 14-d and terminal, respectively). In view of the lack of data in the region of decreasing survival of Chortophaga (14-d) embryos subjected to neutron irradiation, the shape of the dose-effect curve relative to x-irradiation survival was assumed to be unchanged so that an LD_{50} estimate of 370 rads was obtained. The RBE of 14 MeV neutrons and 200 kVp x-rays on Chortophaga (14-d) embryos was 1.76 (obtained from the LD_{50} ratio).

1040 Alexander, M.L. THE RESPONSE OF PRE-MEIOTIC AND POST-MEIOTIC GERM CELLS OF Drosophila TO DOSE FRACTIONATION AND CHANGES IN PARTIAL PRESSURES OF GASES. (Abstr.) p.186 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The relationships of oxygen concentrations and the distribution of x-ray dose were tested by modification of the frequencies of sex-linked recessive lethals, translocations and dominant lethals induced in the germ cell cycle of Drosophila. X-ray treatments were given young males of D. melanogaster held under pressures of 2 atm O_2 plus 3 atm argon gas. In comparative tests, the intracellular oxygen concentration was limited by using 4.3 atm argon. An x-ray dose of 2000 r was given at 25 °C at a continuous rate in 2-min periods, or fractionated into two equal doses 40 min apart at a fast rate. X-ray-treated males were remated every 2 d for 2 weeks. In post-meiotic sperm and spermatid germ cells, fast and fractionated doses gave similar results for all three types of genetic damage with the oxygen-argon mixture. When oxygen was limited with treatment under 4.3 atm argon, higher percentages of recessive lethals and translocations were observed in spermatid cells with fractionated than with fast doses. Dominant lethals were not modified in post-meiotic cells with fast or fractionated doses in either gas environment. In spermatogonial cells, dominant lethals were increased by fractionating the dose in both argon and oxygen + argon. The germ cell cycle of D. virilis was tested for protecting actions of the inert gases, helium and argon. Dominant lethal damage was tested in 1 atm air, 1 atm air + 9 atm helium, and 1 atm air + 9 atm argon. Neither inert gas, at 9 atm pressure, suppressed lethal damage below the air test.

1041 Alexander, M.L. OXYGEN EFFECTS AND DOSE FRACTIONATION IN THE DEVELOPING GERM CELLS OF Drosophila virilis. (Abstr. 5.45) p.70-1 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press, 1963.

1-d-old males of D. virilis were treated with 1000 r of x-rays while under 74.7 lb pressure of argon gas and in a gaseous atmosphere of 45 lb argon + 19.7 lb O_2. X-rays were given at a rate of 1000 r/min as a single dose and as two doses fractionated by a period of 40 min. Additional tests were made with 2000 r under 64.7 lb of argon. Postmeiotic, meiotic and premeiotic germ cells were tested for induced biological damage. Dominant lethals in postmeiotic sperm and spermatid cells were increased by the presence of oxygen. In sperm and spermatids, there were no differences in the percentages of dominant lethals or translocations with dose rate changes in argon or when O_2 was present. These results differed from those observed for D. melanogaster where dose fractionation in argon, but not oxygen, increased translocations, sex-linked lethals and dominant lethals in spermatids. The premeiotic cells of virilis, as melanogaster, showed an enhancement in dominant lethals with dose fractionation in both anoxic and oxygenated gases. Enhancement with dose fractionation in virilis appears to be limited to later spermatogonial stages. The stem cells do not respond to dose fractionation. Enhancement of lethals in premeiotic cells has been observed in anoxic and oxygenated atmospheres of gases in both species. Differences in response of spermatid cells in virilis and melanogaster may be due to oxygen metabolism or other metabolic differences in the two species. Spermatogenic cysts are not prevalent in young males of either species and the differences cannot be explained by mixed populations of resistant and sensitive spermatid cells.

1042 Alexander, M.L., Bergendahl, J. RADIATION SENSITIVITY IN SPERM TREATED IN MALES AND INSEMINATED FEMALES OF Drosophila WITH X-RAYS IN NITROGEN AND AIR. (Abstr. E1) Rad. Res. 16 (1962) 572.

Mature sperm were treated with 4000 r of x-irradiation, simultaneously, in mature males and inseminated females of D. melanogaster. One treatment was in air and the other in nitrogen. Translocations and sex-linked recessive lethals were tested the 1st and 2nd day after treatment. In air, the results for inseminated females were 9.37% (3/32) the 1st day and 10.72% (43/401) the 2nd day for sex-linked lethals; for translocations, 18.05% (39/216) and 17.29% (82/474) were observed for the 1st and 2nd days. For sperm treated in males (air), the results were 9.66% (109/1128) and 7.00% (57/814) sex-linked lethals and 9.85% (52/528) and 7.51% (42/559) translocations the 1st and 2nd days. In N_2, the results for inseminated females were 4.76% (7/147) and 8.19% (62/757) for sex-linked lethals the 1st and 2nd days. For translocations, 4.87% (20/411) and 8.03% (55/685) were observed the 1st and 2nd days. Mature males gave results of 5.83% (78/1338) and 5.26% (66/1255) for sex-linked lethals and 3.95% (22/557) and 3.85% (21/546) translocations the 1st and 2nd days. In both gases, totals for both days show higher translocation and sex-linked lethal percentages induced in sperm in inseminated females than in males. High translocation values indicate that chromosome breakage is an important factor for increased sensitivity. Genetic damage was not reduced consistently the 2nd day after treatment to indicate that recovery mechanisms act in males. The data indicate that postirradiation enhancement in air may result the second day after treatment in N_2 in inseminated females.

1043 Amer, N.M. MODIFICATION EFFECTS WITH MAGNETIC FIELDS. p.55-8 in "Biology and Medicine. Semiannual Report, Spring 1963". UCRL-11033, California. Univ., Berkeley. Donner Lab. and California. Univ., Berkeley. Donner Pavilion.

A modifying effect of a constant magnetic field on the course of wing development was demonstrated in Tribolium confusum irradiated as pupae using 1200 r of 250-kVp x-rays at rate of 1000 r/min. The effects of temperature are discussed. (NSA 18:1964, 5006)

1044 Amherst Coll., Mass. GENETIC AND DIRECT EFFECTS OF γ RADIATION ON Drosophila. Progress Report 1962. TID-19003. 10p.

Progress is reported in studies of the mutagenic effects of different dosage levels of γ rays during various stages of spermatogenesis in Drosophila melanogaster under controlled, varied genetic and environmental conditions. Data are presented on the dosage-mutation rate pattern during spermatogenesis, the relation between developmental temperature and mutational response to γ irradiation, and the organization of genetic material on chromosomes. An analysis was made of a natural population of D. melanogaster. A list is included of publications during the period. (NSA 17:1963, 28683)

1045 Baumhover, A.H. INFLUENCE OF AERATION DURING GAMMA IRRADIATION OF SCREW-WORM PUPAE. J. econ. Ent. 56, 5 (1963) 628-31.

Screw-worms (Cochliomyia himinivorax (Coquerel)) have shown variable response to the standard dose level of γ-rays from Co^{60}-sources used in routine production of sterile flies. The primary influence was found to be availability of O_2 during irradiation. When pupae were irradiated in a CO_2 atmosphere, a dosage of 11 000 r was required to sterilize the females, compared with only 5500 r to 6200 r required in O_2 and air (forced ventilation). Anoxia induced by consumption of O_2 by the pupae produced radiation-protection effects that were intensified by delay prior to irradiation and/or increased rate of O_2 uptake as pupae advanced in age. In practical tests, a canister made of 1/8-inch mesh Al screen provided sufficient diffusion of air to standardize the dosage safely at 6900 r, with up to 30 min delay prior to treatment for pupae 5 d of age or older. This dosage reduces by 50% that required under maximum conditions of anoxia encountered in production when a closed canister is used. (Auth.)

1046 Biellmann, G. EFFETS D'IRRADIATIONS LOCALISÉES CHEZ Locusta migratoria L. Bull. Soc. Zool. France 86, 1(1961) 99-106.

1047 Burdette, W.J. INFLUENCE OF PENICILLIN ON FREQUENCY OF INDUCED MUTATION. Proc. nat. Acad. Sci., Wash. 47 (1961) 1813-7.

The frequency of lethal mutations induced in the X chromosome of Drosophila by x-irradiation (3000 r at 500 r/min) is diminished to 1/3-1/2 by administration of penicillin in concentrations above a threshold value (20 000 u/ml). The diminution in percentage of mutations occurs in all stages of spermatogenesis tested. Enhancement of mutation frequency by O_2 is curtailed by administering penicillin both in the stages of gametogenesis with greatest frequency of lethals and when all stages are combined. The number of heritable tumours in the susceptible strain of Drosophila used are also reduced both by penicillin and irradiation.

1048 Burdette, W.J. ALTERATION OF MUTATION FREQUENCY BY TREATMENT WITH ACTINOMYCIN D. Science 133 (1961) 40.

The frequency of lethal mutations occurring in Drosophila melanogaster was reduced by approximately 1/2 when (x-) irradiated males were treated with actinomycin D, which also inhibited the appearance of melanotic atypical growths in the strain used for the study. (Auth.)

1049 Capps, A.S. THE EFFECTS OF NITRIC OXIDE ON RADIATION DAMAGE IN Drosophila virilis AND Drosophila melanogaster. Genetics 46, 2 (1961) 123-7.

Nitric oxide present during irradiation at a concentration of 3% in He enhanced genetic damage resulting from 1000 r of x-rays. Damage was measured by the production of dominant lethals in D. virilis and sex-linked recessive lethals in D. melanogaster. Under similar conditions 3% O_2 in He showed no effect on the production of dominant lethals by x-rays. Nitric oxide had the additional effect, independent of irradiation, of delaying development of germ cells in D. virilis. (Auth.)

1050 Carfagna, M., DeCapoa, A., Duraccio, F. EFFECTS OF A PROLONGED EXPOSURE OF ARTIFICIAL POPULATIONS OF Drosophila melanogaster TO $MnCl_2$. Genet. agr. 16, 1/4 (1963) 354-64. (In Italian).

Populations of D. melanogaster were exposed to 0.2-0.6% $MnCl_2$ and simultaneously to x-rays (500 r/generation). Fertility was significantly decreased after 20 generations of $MnCl_2$ exposure. (CA 61: 1964, 4762 b)

1051* Chang, T.H., Wilson, F.D., Stone, W.S. GENETIC RADIATION DAMAGE REVERSAL BY NITROGEN, METHANE, AND ARGON. Proc. nat. Acad. Sci. 45 (1959) 1397-1404.

1052* Chang, T.H. REDUCTION OF THE SEX-LINKED RECESSIVE LETHAL FREQUENCIES IN Drosophila melanogaster BY ARGON, NITROGEN, AND METHANE UNDER PRESSURE. Dissertation. The University of Texas. 1960.

(Note: An assumption made here that x-rays would produce more lethals in 10 atmospheres of O_2 than in 1 atmosphere has since been proved untenable.)

1053 Chang, T.H. FURTHER OBSERVATIONS ON THE RELATION BETWEEN GAS PRESSURE AND THE X-RAY DAMAGE IN Drosophila melanogaster. p.385-93 in "Studies in Genetics. II. Research Reports on Drosophila Genetics, Taxonomy and Evolution". Wheeler, M.R., Ed. Austin, The University of Texas. 1962.

Increase in air pressure increases the x-ray damage measured as sex-linked and dominant lethals. An increase in pressure of pure O_2, on the other hand, does not. The same is true for argon and N_2. Whereas 8 atmospheres (atm) of argon were not able to counteract the effect of 2 atm of O_2, 9 atm of argon definitely reduces the effect of 1 atm of O_2 almost to the anoxic level. The typical differential response of spermatogenic cells to x-rays was observed: early spermatids are most sensitive to recessive, spermatocytes to dominant lethal induction. This differential response is much less obvious when the flies are treated in anoxia. The high radiosensitivity of spermatids (and spermatocytes) is therefore at least partially attributable to the presence of O_2. Treatment of flies in gases and mixtures without radiation has no effect.

1054 Clark, A.M. THE EFFECTS OF CHLORAMPHENICOL, STREPTOMYCIN AND PENICILLIN ON THE INDUCTION OF MUTATIONS BY X-RAYS IN Drosophila melanogaster. Z. Vererb Lehre 94, 2 (1963) 121-5.

Injection of chloramphenicol, streptomycin or penicillin into Drosophila males just before exposure to (1000 r) x-irradiation causes a reduction in the yield of sex-linked recessive lethal mutations. The effect appears to be primarily on spermatids and possibly spermatocytes. In the absence of x-irradiation, the injections of these antibiotics are certainly not markedly mutagenic in Drosophila.

1055 Clark, A.M., Cristofalo, V.J. SOME EFFECTS OF OXYGEN ON THE INSECT Anagasta kühniella AND Tenebrio molitor. Physiol. Zoöl. 34 (1961) 55-61.

The larvae and pupae of A. kühniella and T. molitor were exposed for 5 min to O_2 at pressures of 15-75 lb/in^2 and the effects were compared with controls maintained in O_2 and air at 15 lb/in^2. Under such conditions A. kühniella pupae were injured and showed decreased O_2 consumption. Larvae, although sensitive to O_2, were more resistant than pupae. Unpigmented T. molitor pupae were injured after exposure to 60 and 120 lb/in^2 O which affected their ability to become pigmented and to consume O_2. A 5000-r dose of x-rays arrested development of T. molitor larvae, whereas 50 000 r were required to arrest development of pupae, although the O_2 consumption of the latter was not decreased after such exposure. (CA 55:1961, 11687 b)

1056 Dubinin, N.P., Grozdova, T.Ya. STREPTOMYCIN, RADIATION, AND NATURAL MUTABILITY. Dokl. Akad. Nauk SSSR. 148 (1963) 1397-9.

Experiments with Drosophila showed that the antimutagenic effect of streptomycin, administered by intra-abdominal injection, affects not only the chromosome rearrangements but also the spot (and gene) mutations. The effect was observed both in the development of sperm characterized by high natural mutability and in the development of the egg cells. No protective action by this drug was found among embryo cells which were irradiated with x-rays at 3000 r dosage. The mutagenic effect of streptomycin was not observed in these tests. Administration of streptomycin lowered the natural mutability of males, caused by metabolic peculiarities in the early pupal stage. This result indicated that either potential changes in chromosomes exist in case of natural mutagenesis or that mutagenic agents exert their action on the sperm only after a certain period after administration. (CA 58:1963, 14494f)

1057* Ellis, J.F., Harris, T.M., Ostheimer, J.T., Plough, H.H. THE EFFECTS OF COMBINED GAMMA RADIATION AND ETHER TREATMENT ON THE FREQUENCY OF EGG LETHAL IN Drosophila melanogaster. Rec. Genet. Soc. Amer. 26 (1957) 368.

1058 Falk, R. NITROGEN-TREATMENT EFFECTS ON REARRANGEMENT-INDUCTION PATTERNS IN Drosophila melanogaster. Int. J. Rad. Biol. 4, 5 (1961/2) 437-55. (In English)

Recovered rates of Y-chromosome-autosomal translocations (Y-A) induced in spermatids of pupae of D. melanogaster, as well as the chromosomes 2-3 translocations (2-3), were higher in crosses to females having an attached X.Y-chromosome than to regular females. This suggests that numerous position-effect sterility mutations were induced in the Y-chromosomes as well as in the autosomes. N_2-treatment after irradiation of 800 r did not increase the frequencies of translocations recovered. Prolonged N_2 pre-treatment apparently retarded development so that irradiation involved an earlier and more sensitive stage of spermiogenesis than without pre-treatment. When two irradiations were given 14 h apart in air, breaks induced in the 1st irradiation rejoined prior to the 2nd. The change in the frequency of X-chromosome recessive lethals over the 14 h separating the two irradiations applied to the spermatids is much larger than that of breaks involved in translocations. At least some recessive lethals are apparently caused by intra-genic mutations as opposed to inter-genic breaks.

1059 Fritz-Niggli, H. BEEINFLUSSUNG DER STRAHLENINDUZIERTEN MUTABILITÄT DURCH 2,4-DINITROPHENOL BEI Drosophila. (Modification of the radio-induced mutability in Drosophila by 2,4-dinitrophenol.) Naturwissenschaften 48 (1961) 650-1. (In German).

The variability of the radio-induced mutation rate with the age or development state of the germs cells can be used as an indication of a dependence of the mutation genesis on the intracellular metabolism of the cells. Therefore the effect of 2,4-dinitrophenol on the mutation rate of D. melanogaster was investigated. The results established that treatment with this chemical before irradiation diminished drastically (approximately fourfold) the number of radio-induced recessive lethal factors and chromosome losses by rupture. (NSA 16:1962, 6360).

1060 Giavelli, S., Callucci, E., Pozzi, L.V., Sironi, G.P. PRELIMINARY RESULTS OF COMBINED EFFECTS OF OXYGEN AND LOW TEMPERATURES ON MUTATIONS INDUCED BY X-RAYS IN Drosophila. Atti Ass. genet. ital. 8 (1963) 194-204. (In Italian).

In order to study the mechanism of the oxygen effect in x-ray-induced mutations, D. melanogaster Oregon-R males were irradiated in oxygen at 25°C and 0°C., thus at normal and low metabolism. Sex-linked x-ray-induced recessive lethals were scored, and no difference was found in the mutation frequency induced by the two treatments at different temperature. The oxygen effect was considered independent from the metabolism of the irradiated cells. (Auth., NSA 17:1963, 28710)

1061* Glass, B., Mettler, L.E. THE OXYGEN EFFECT IN RESPECT TO POINT MUTATIONS IN Drosophila melanogaster. p.97-8 in "Proceedings of 10th International Congress of Genetics, McGill University, Montreal, 20-27 August 1958. Vol.II". Toronto, University of Toronto Press. 1958.

1062 Glembotskiĭ, Ya.L., Parfenov, G.P. GENETIC EFFECTS OF SPACEFLIGHT FACTORS. Probl. Kosmich. Biol. 2 (1962) 98-114.

With the object of investigating effects of spaceflight factors on heredity, Drosophila melanogaster was carried on the 2nd, 4th, and 5th orbital spaceships and on Vostok-1 and Vostok-2. Four different spaceflight effects were investigated. Non-disjunction of chromosomes was investigated by exposing unfertilized white-eyed Drosophila females on Vostoks 1 and 2 and mating them on their return with red-eyed males. Primary non-disjunction of chromosomes resulted in the appearance of 4 times as many unusual genotypes (XXY females and XO males) among the progeny of the exposed group as among offspring of the controls. However, the increase in non-disjunction cannot be ascribed to radiation effects. Induced crossovers were investigated by exposing heterozygotic males (having normal phenotypes but three recessive genes in the second chromosome) on the 5th orbital spaceship and on Vostoks 1 and 2. Upon return they were mated with homozygotic females displaying the 3 recessive characteristics (black body, cinnabar eyes, and vestigial wings). Drosophila carried in the fifth orbital spaceship with no protection against low-frequency vibrations showed crossover incidence of 0.50 ± 0.12%, compared to an incidence of 0.05 ± 0.05% or none at all on Vostok spaceships, where the insect containers were cushioned against vibration. Dominant lethal mutations were investigated by exposing two strains of D. melanogaster (D-18 with a high rate of spontaneous lethal mutations, and D-32 with a low rate for the same mutations) of the 5 spacecraft. The number of dominant lethal mutations was found to increase somewhat in all groups exposed to space flight. Sex-linked recessive lethal mutations were investigated by exposing young males of the D-18 and D-32 strains of D. melanogaster on all 5 vehicles. Exposure on the 2nd and 4th orbital spaceships and on Vostok-1 resulted in statistically significant numbers of sex-linked recessive lethal mutations for spermatozoa and spermatids of both strains. However, no increase in mutations was observed following exposure on the 5th orbital spaceship and on Vostok-2. (NSA 17:1963, 21549. See also abstr. 27200)

1063 Guyenot, E., Kiortsis, V., Uehlinger, V. EFFECT OF FRACTIONATING DOSES ON THE RATE OF X-RAY-INDUCED MUTATIONS IN Drosophila. Ann. Genet. 4 (1961) 55-62. (In French).

The present experiment was conducted on D. melanogaster to determine to what extent fractionation of dose increases or decreases mutation. X-irradiation was administered in 3 ways: continuously, for 10 min; fractionated, with an interval of 9/10 min between 1/10-min exposures at an average rate of 70 r/min; fractionated, with an interval of 1/16 min. In all 3 cases the total amount of radiation was 700 r. The mutation considered was a sex-linked, lethal recessive in a wild strain of the fruit fly crossed with the Muller 5 strain. According to formulae evolved previously, the average rate of mutation was found to be 12-13% less with short intervals than with continuous irradiation, and 19% less with long intervals than with continuous irradiation. These results were obtained from 21 series of irradiations spread over 3 stages, each consisting of 2 groups. Stage A was observed 1-3 d after irradiation; stage B, 4-6 d after; and stage C, 7-9 d after. The mutation rate was concluded to be progressively reduced when the interval of protection between the fractionated x-ray doses was increased. In the case of point mutations, there is evidence for a recovery phenomenon in the various stages of male gametogenesis. (From NSA 17:1963, 38766)

1064 Henke, H., Höhne, G., Künkel, H.A. ÜBER DIE WIRKUNG VON AMINOAETHYLISOTHIURONIUM (AET) AUF DIE STRAHLENINDUZIERTE MUTATIONSRATE BEI Drosophila melanogaster. (Study on the effect of amino-ethylisothiuroniumchloride-hydrochloride (AET) on radiation-induced mutation rate in Drosophila melanogaster.) Strahlentherapie 122, 2 (1963) 279-84. (In German)

The influence of AET on the (x-ray)-induced mutation rate of sex-linked recessive lethals was determined using the Muller-5-method. A significant increase in mutation rate was observed after the administration of AET, known as a radiation protective substance with regard to somatic damage. Chemomutagenity did not occur. The sensitizing effect was observed in sperm of different degrees of maturity.

1065 Hoenigsberg, H.F., Callucci, E., Giavelli, A. THE OXYGEN EFFECT IN IRRADIATED MATURE AND MEIOTIC GERM CELLS OF Drosophila melanogaster. Experientia 17, 4 (1961) 172-4.

The radiosensitivity spectrum of spermatogenesis was established for 5 doses (150, 300, 600, 1200 and 2400 r) of x-radiation applied at 200 r/min, and corresponding tests were carried out on the O_2 effect. Increased mutability was observed in the presence of O_2, but not at all stages of spermatogenesis. A higher frequency of recessives occurred in meiosis than in mature sperm. While, at lower doses, no apparent O_2 effect was observed on mature sperm although a clear effect was observed in meiotic cells, at higher doses the O_2 effect extended to both mature sperm and meiotic stages. The most sensitive period was the one immediately following exhaustion of the mature sperm supply under the experimental conditions described. Nitrogen was observed to have a protective effect.

1066 Ives, P.T. THE EFFECTS OF DEVELOPMENTAL TEMPERATURE ON MUTATIONAL RESPONSE TO GAMMA RAYS IN Drosophila SPERMATOGENESIS. (Abstr.) Amer. Zool. 2 (1962) 417.

1067 Japan. Sericultural Experiment Station, Tokyo. STUDIES ON THE BREEDING METHOD TAKING ADVANTAGE OF γ-RAYS IN THE SILKWORM. Nucl. Sci. Abstr., Japan 1 3/4 (1962) 170-1. (In English).

The effects of γ-ray treatment on the following generation with regard to hatchability, survival rate at the larval stages, pupation rate and quantitative characteristics of the coccoon are almost the same for fractional irradiation of successive generations and a single treatment of one generation, provided that the stage of the silkworm at irradiation and the total doses given are the same. Linear dose-action curves are obtained in both cases. Damage tends to be less with fractional irradiation. When one generation only is treated the lower the dose the faster generation recovery takes place for doses < 4 kr. Strains with survival rates under normal conditions are also rather resistant to γ-rays. Resistance to radiation damage of F_1- and F_2-hybrids is greater than that of parents, with F_1-hybrids more resistant than F_2-hybrids,

1068 Japan. National Inst. of Genetics, Mishima. STUDIES ON THE GENETIC EFFECT OF RADIATION WITH SILKWORM. Nucl. Sci. Abstr., Japan 2, 2 (1963) 72-3. (In English).

Two types of dose rate dependence of radiation-induced mutation frequency have been found in early gonial cells of silkworm, differential repair and selective killing being suggested. Further evidence has been collected supporting the hypothesis of selective killing. Variations in induced mutation frequency were studied along with the development of germ cells, for acute and chronic irradiation. Results from cytological studies suggest that germ cells acutely irradiated at the primary and secondary spermatogonial stages must have been killed eventually, observed mutation frequency reflecting that of repopulated cells dormant at the time of irradiation while, under chronic irradiation some cells at advanced stages are able to survive a higher mutation frequency being observed.

1069 Japan. National Inst. of Radiological Sciences, Chiba. MUTATION RATES AT LOW LEVEL IRRADIATION IN Drosophila melanogaster. Nucl. Sci. Abstr., Japan 2, 2 (1963) 93-4. (In English)

The Canton-S strain of D. melanogaster was used as wild type material, isogenization being performed every 4 months. Wild males were stocked for 1 week after their emergence, and irradiated with 145 r/min x-rays for high doses (1000-4000 r) and 4 r/min for low doses (8-25 r). Evidence was obtained indicating that the linear relationship between mutation rates and radiation dose can apply to doses down to 8 r, sex-linked recessive lethal mutations being used as indicators. No threshold dose was observed for the genetic effects of radiation down to 8 r.

1070 Kostolanska, A. INFLUENCE OF POST IRRADIATION CHANGES IN THE EGGS OF Bombyx mori L. AT A LOWERED TEMPERATURE. Biológia, Bratisl. 17, 8 (1962) 626-8. (In Czech, with German summary)

1071 Krebs, J.J.F. THE EFFECT OF REPEATED X-RAY EXPOSURE UPON THE GENETIC LOAD AND MUTABILITY OF Drosophila melanogaster. Thesis. Saint Louis Univ. 1963. 48p.

1072 Künkel, H.A., Oberheuser, F. ULTRAFRACTIONATION AND BIOLOGICAL EFFICIENCY OF FAST ELECTRONS. INVESTIGATIONS ON "EGGS" OF Drosophila melanogaster OF DIFFERENT STAGES OF DEVELOPMENT. (Abstr.) p.6 in "2nd International Congress on Radiation, Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Experiments were carried out with a 16-MeV betatron. By means of a special electronic design it was possible to quench radiation pulses in the injector of the accelerator. In this way the frequency of radiation pulses was varied between 2 and 50 cps. To compare this ultrafractionated radiation with continuous radiations, β-rays from a Sr^{90} source as well as γ-rays from a Co^{60} source were used. The influence of ultrafractionation on biological efficiency was investigated in Drosophila "eggs" at the "age" of 1.75, 4.5 and 6 h. Dose-effect curves were determined for each group keeping constant either the average dose rate or the dose rate of the particular radiation pulses.

1073 Künkel, H.A., Rösner, A. EXPERIMENTS WITH CHEMICAL COMPOUNDS WHICH REDUCE OR INCREASE MUTAGENIC EFFECTS OF IONIZING RADIATIONS. (Abstr. 5.35). p.67 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963, Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

This paper deals with investigations on 3 chemical compounds well known as radioprotecting agents with regard to somatic radiation damage: cysteine, aminoethylisothiuronium (AET) and 5-hydroxytryptamine (serotonin). Experiments were carried out on Drosophila and on E. coli. In Drosophila the rate of ray-induced sex-linked recessive lethals was tested after x-irradiation by means of the Muller-5-Method. No influence of cysteine was observed in Drosophila. Serotonin reduced the rate of mutations in Drosophila as well as in E. coli. Protection, however, was only small. After AET the ray-induced rate of mutations significantly increased although this compound per se has no mutagenic effect. Lastly experiments are reported with bromodeoxyuridine which is incorporated into DNA instead of thymidine and provides increased radiosensitivity in some cases.

1074 LaChance, L.E. POST-IRRADIATIVE EFFECTS OF NITROGEN AND CARBON MONOXIDE ON HATCHABILITY OF Habrobracon EGGS TREATED IN FIRST MEIOTIC METAPHASE. Int. J. Rad. Biol. 4 (1961/62) 15-20.

The effect of N_2 and of CO administered as post-radiation treatments (x-rays) was investigated. The hatchability of Habrobracon eggs treated in first meiotic metaphase was taken as the criterion of damage.

Both gases are equally effective in enhancing the damage induced by the radiation. Since restitution is thought to be rare in irradiated metaphase oöcytes, the action of these gases is considered as altering a repair mechanism which results in allowing potential damage to become actual. (Auth.)

(Also published as BNL-4981, Brookhaven National Lab., Upton, N. Y.)

1075 LaChance, L.E. ENHANCEMENT OF RADIATION-INDUCED STERILITY IN INSECTS BY PRETREATMENT IN CO_2 + AIR. Int. J. Rad. Biol. 7, 4 (1963) 321-31.

When the pupae of the screwworm fly (Cochliomyia hominivorax (Coquerel)) are irradiated in an atmosphere of CO_2 + air (50-50 mixture), damage to the reproductive system measured in the adult female is greater than that induced by a similar radiation treatment delivered in air. Doses of γ-radiation ranging from 2500 to 5000 r were investigated. In all tests the number of females ovipositing, the number of eggs per fecund female, and the egg hatchability were reduced. For CO_2 to be effective in enhancing radiation damage air must be present, and the pupae must be pretreated in the gas mixture for approximately 45 min. Complete sterility can be induced by a treatment of 4500 r delivered in CO_2 + air, whereas irradiation in air alone requires about 5500 to 6200 r to induce complete sterility. Irradiation in CO_2 + air is more damaging to the reproductive system than irradiation in pure O_2. (Auth.)

1076 Löbbecke, E.A., Oltmanns, O. ON A CHANGE IN THE SPECTRUM OF SOMATIC MUTATIONS IN Ephestia kuehniella Z. BY TEMPERATURE TREATMENT BEFORE IRRADIATION. Z. VererbLehre 92 (1961) 246-51.

Pupae were maintained at different temperatures (-7, 3, 30, 35, 40°C) for 6 h before being exposed to 800-r doses of x-rays. The incidence of 4 types of scale mutations (ES 1, ES 2, ES 3, ES 4) in the butterflies was studied. It was found to vary significantly according to temperature. The ratio of ES 1/ES 2 mutations was lowest (5:1) at -7° and highest (11:1) at 35°C. The ES 1 mutant showed highest frequency at 25° and fell to the lowest value after preincubation at 40°C. The ES 2 mutant reached its lowest incidence at 35°. The ES 3 mutant varied inconsistently and ES 4 frequency was only slightly dependent on temperature. The preincubation temperature of 40°C, the lethal limit for the species, generally depressed mutation frequency. The precise reason for the effect of temperature on mutation frequency is unknown but it was previously found that chromosome fragmentation and translocation were reduced at elevated temperatures. (NSA 17:1963, 23206)

1077 Markus, B., Sticinsky, E. EXPERIMENTS ON THE EFFECT OF THE ENERGY SPECTRUM OF FAST ELECTRONS ON BIOLOGICAL REACTIONS. Strahlentherapie 115 (1961) 394-403. (In German)

After a survey of the present knowledge about the LET (linear energy transfer) spectrum of fast electrons and of the possibilities for the examination of its influence on biological reactions experimentally, radiation tests with eggs of Drosophila with 14.2-MeV electrons are described. The eggs were irradiated in a plexiglass phantom at depths of 100, 30, and 20% of the relative depth dose under specially controlled conditions with the same ionization dose of 200 r (verging on LD_{50}) with 65 r/min. As opposed to the 100% depth, the damage rate at the 30 and 20% depths was 19 to 22% higher. A discussion of the methodic influences, especially of dosimetry, shows a true effect. (Auth.)

1078 Markus, B., Sticinsky, E. THE ACTION OF 14-MeV ELECTRONS, 14-MVp AND 200-kVp X-RAYS AND THE INFLUENCE OF THE ENERGY SPECTRUM OF 14-MeV ELECTRONS ON EGGS OF Drosophila. (Abstr.) p.244 in "2nd International Congress of Radiation Research, Harrogate, Yorkshire, England. 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The effect of an ionization dose of 200 r on Drosophila eggs of mixed ages of 0.5-3 h was described previously for 14 MeV electrons. The LET of the radiation was varied by exposing the eggs at different depths of a Perspex phantom. The depth doses corresponded to 100%, 30% and 20% of the incident beam intensity. The experiments have been extended using eggs of 1 h, 1.75 h and 4 h of age and using 14 MVp and 200 kVp x-rays. Intercomparisons are given for the biological effectiveness of the different radiations used for different depths in the phantom. The RBE varied with the age of the eggs. The effectiveness of the radiations increased with the depth of the phantom. X-rays of both energies were more effective than 14 MeV electrons. This difference was more pronounced the older the eggs at the time of irradiation. Observations are based on doses of 150 r, 300 r and 700 r, and are compared with results of Fritz-Niggli and Schinz.

1079 Markus, B., Sticinsky, E. DER EINFLUSS DES ENERGIESPEKTRUMS VON 14-MeV-ELEKTRONEN UND DIE VERGLEICHSWEISE WIRKUNG VON 14-MeV-ELEKTRONEN, 14-MV- UND 200-kV-RÖNTGENSTRAHLEN AUF Drosophila-EIER. (The effect of the energy spectrum from 14 MeV electrons, and the relative effects of 14 MeV electrons and 14 MV and 200 kV x-rays on Drosophila eggs.) Strahlentherapie 120, 2 (1963) 262-8. (In German).

In experiments on the (LET)-spectrum of fast electrons on biological reactions, a significant effect on damage rate of Drosophila embryos (aged 1, 1.75 and 4 h) was found in all 3 age-groups with electrons of 14.2 MeV. The effect was most marked at 4 h when, with an ionization dose of 700 "r", given in a plexiglass-phantom at a depth of 30% relative depth dose, a damage rate of 230% is produced, against 100% at a depth of 100% relative depth dose. The effects of 14 MeV-electron-irradiation at 100% depth showed significant differences for all 3 age-groups, compared with 200 kV or 14 MV x-rays.
For an equal ionization dose, the effect of fast electrons was always less than that of x-rays. The differences in efficiency showed a characteristic dependence on age. Between 200 kV and 14 MV x-rays there was no difference at 1 h, but with advancing age increasing differences were observed. The results are compared with those of Fritz-Niggli and Schinz.

1080 Martin, V.J., Burson, D.M., Bull, J.C., Cornwall, P.B. THE EFFECT OF CULTURE ENVIRONMENT ON THE SUSCEPTIBILITY OF THE GRAIN WEEVIL Sitophilus granarius L. TO GAMMA RADIATION. AERE-R-3893, United Kingdom Atomic Energy Authority. Research Group, Isotope Research Div., Wantage, Berks, England, 1962. 26p.

The lethal effect of gamma radiation on adult grain weevils is increased by culture densities which cause a substantial rise in metabolic temperature above 26°C during larval development. Densely crowded cultures in which temperatures during growth and maturation of larvae do not rise appreciably above 26°C, fail to modify the adult's lethal response. Temperature fluctuations up to 36°C during development do not modify the susceptibility of the adult to radiation sterilization. Accordingly, the efficacy of 16 000 rads for control of grain weevils is unlikely to be reduced by population densities normally encountered in commercial storage. (Auth.)

1081 Makino, S. EFFECTS OF RADIATIONS ON CELL DIVISION AND CHROMOSOMES IN ANIMALS. Final Report No.2, 15 Dec. 1961-14 Dec. 1962. AD-403 109, Hokkaido Univ., Sapporo, Japan. 12p.

Effects of radiations on cell division and chromosomes in animals were studied. Effects of x- and β-irradiations on grasshopper spermatocytes were investigated using various chemicals with special regards to their radioprotective effects. X-ray effects on Drosophila spermatogenesis were also studied. The remaining investigations were not concerned with insects.

1082* Meyer, H.U., Ehrlich, E.F., Muller, H.J. TOLERANCE OF GONIAL CELLS OF Drosophila melanogaster FOR HEAVY X-RAY DOSES DIVIDED INTO INSTALLMENTS. (Abstr.) Genetics 44 (1959) 527.

To explore ways of obtaining offspring from heavily irradiated gonia, x-ray instalments of 1500 r, 3000 r, and 4000 r were given to young imagoes. To promote gonial proliferation, instalments were separated by 2-, 4-, 5- or 8-d intervals, during which the flies fed and reproduced actively. Adult offspring from eggs laid in successive broods after the last irradiation were counted. After female irradiation, only the first two 4-d broods (from treated oöcytes) were strongly affected by size of instalment. The earliest broods representing treated gonia (brood 3 from treated females, broods 4 and 5 from treated males) gave the highest yields. Four-day intervals gave distinctly higher yields than 2-d, but not much lower than 8-d intervals. Tolerance varied greatly with genotype. Thus, with 4000 r instalments 5 d apart, 8000 r sterilized all oögonia of a homozygous stock marked only by veinlet, while 24 000 r allowed some oögonia of normals from outcrosses to reproduce. With similarly given instalments, 12 000 r sterilized all spermatogonia of yellows while 24 000 r allowed some spermatogonia of Stubbles to reproduce. In experiments ranging from 6000 r to 24 000 r, the yield of offspring from treated oögonia was approximately halved by each 3000 r given (as contrasted with 2000 r for the halving dose earlier found when late spermatozoa are irradiated in males). The following sex-linked lethal frequencies were induced in oögonia in the last-mentioned series: 12 000 r (3000 r instalments), 13/244; 16 000 r (4000 r instalments), 15/175; 24 000 r (4000 r instalments), 19/125; that is, 1% per 2000 r. Crossover tests showed these very rarely to include gross structural changes.

1083 Mittler, S. AET AND MEA AS PROTECTION AGAINST RADIATION INDUCED CHROMOSOMAL ABERRATIONS IN Drosophila. (Abstr.) Genetics 48, 7 (1963) 902.

AET or MEA were injected near the testis of Drosophila 6 to 12 h after emergence and the flies irradiated with 2000 r of 100 kV x-rays in air. The males were mated at ratio of 1 : 3 females and transferred to a new group each 3 or 4 d. AET at concentration of 1058 mg/kg did not protect Oregon-R X chromosome as indicated by the M-5 method from recessive sex linked lethals. The brood representing spermatids and spermatocytes at the time of irradiation yielded more mutations than the control. AET did not protect against deletion of the X chromosome of Oregon-R male as shown by induced hyperploidy of attached X females with a γ marker. Injection of MEA at 1411 and 3530 mg/kg did not protect X chromosome of $sc^{8}Y(\gamma^{+})/\gamma B$ males against radiation induced recessive lethals when mated to a multi-purpose stock γ $sc^{SI}In49\,sc^{8}$, bw, stpP. Again the radiosensitive stages in spermatogenesis, the spermatids and spermatocytes, are induced to produce more rather than less mutations. MEA did not protect against radiation induced translocations between chromosomes 1 and 3. (From abstr.)

1084 Mittler, S. STUDIES OF CHEMICAL PROTECTION AGAINST RADIATION INDUCED MUTATIONS. (Abstr. B1B330) p.37 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

Sulfhydryl compounds, which are effective in protecting mammals from death by irradiation will be studied with respect to chemical protection against induced mutations, and chromosome translocations, and deletions in Drosophila melanogaster. MEA, 2 mercaptoethylamine, and AET, 2 aminoethylisothiouronium bromide, will be injected near the testes of the fly which will then be irradiated with 2000 r from an x-ray source. Recessive sex linked lethal mutations will be determined by the M-5 method and translocations between II and III chromosome by bw: st method. The protection, if any, against deletions of the X chromosome will be determined by the (attached) X method. Preliminary experiments indicate that the sulfhydryl compounds are not protecting against genetic damage, but are enhancing it. This may be due to some inhibition of a recovery process.

1085 Mossige, J. OXYGEN-EFFECT ON MUTATION-RATE INDUCED IN DIFFERENT STAGES OF SPERMIOGENESIS IN Drosophila melanogaster BY 31-MeV ELECTRONS AND 180-kV X-RAYS. (Abstr.) p.244 in "2nd International Congress of Radiation Research, Harrogate, Yorkshire, England. 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The purpose of the present investigation is to determine whether the oxygen-effect on Drosophila sperm could be modified by LET. A comparison is made between the brood patterns obtained by irradiating newly eclosed males with 31-MeV electrons from a betatron, and 180-kV conventional x-rays in an atmosphere of oxygen or of nitrogen. The electron doses are measured with a Baldwin Farmer substandard dosemeter, and the x-rays with a Duplex integrating dosemeter. The males are mated each day with 5 new females and the progeny tested for recessive sex-linked lethals by the standard Basc method. Peak sensitivity is usually found on the 5th day, and this day also reveals the greatest modification of sensitivity by both O_2 and N_2. In an experiment with a dose of 375 r in O_2 and 750 r in N_2, the O_2 enhancement factor for Day 5 was 2.5 for x-rays and 3.8 for electrons, while it was about 1 on Day 1 with x-rays and with electrons. Preliminary experiments at higher doses indicate an even greater enhancement on Day 5. Further experiments are in progress to confirm this finding.

1086 Mossige, J. DIFFERENTIAL YIELDS OF MUTATIONS FROM THE FIRST AND SECOND MATINGS AFTER IRRADIATION OF MATURE SPERM IN Drosophila melanogaster. (Abstr.) Hereditas 48, 3 (1962) 543.

See 1087.

1087 Mossige, J.C. DIFFERENTIAL YIELDS OF MUTATIONS FROM THE FIRST AND SECOND MATINGS AFTER IRRADIATION OF MATURE SPERM IN Drosophila melanogaster. p.253-74 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Young males yield lower frequencies of sex-linked lethals and II to III translocations over the age range tested, from newly eclosed to 7 d for lethals and from newly eclosed to 3 d for translocations. The first sperm available in the newly eclosed males, 0 to 4 h old, yield the same frequencies of both translocations and sex-linked lethals when irradiated in nitrogen or air, but the frequencies are enhanced in oxygen. When the sperm have been stored for 3 d in the male there is both a decreas in N and an increase in O as compared to air. It is concluded that the most mature sperm in 0 to 4-h-old males are relatively anoxic. When irradiated in N, air, or O these young sperm give a decreased frequency of sex-linked lethals from the 1st to the 2nd mating with single females, and a continued decrease of the lethal frequency with time up to about 24 h. Sperm irradiated in 2 d-old males in air also show a marked decrease from the 1st to the 2nd mating and a further decrease in the frequency with time up to about 9 h. In 7-d-old males there is a decrease from the 1st to the 2nd mating immediately after irradiation but no further decrease with time. In 3-d-old males irradiated over a dose range of 445 to 3000 r in air, N, and O there was a tendency toward a decrease from the 1st to the 2nd matings, within 5 h, in air and O, but none in N. It is suggested that the decrease often observed between 1st and 2nd sperm batches is due both to a difference in O sensitivity between the first sperm available and those next in line in males of all ages, and to a recovery with time of all mature sperm from males at least up to 2-d-old, which is independent of the atmosphere in which the irradiation was performed. (Auth.)

1088 Müller, I. CHANGES IN THE MUTATIONAL SPECTRUM OF SOMATIC MUTATIONS IN Ephestia BY PRE-TREATMENT WITH LOW AND HIGH TEMPERATURES. p.154 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Scales on the hind wings of Ephestia kuehniella are of uniform shape and colour. After irradiation of pupae, single mutated scales of different appearance are found. There are 4 kinds of mutant scales, each one with a characteristic mutation rate after irradiation in a standard environment. In a pilot experiment Löbbecke and Oltmanns found that it is possible to change the relative frequencies of these mutant types by variation of the temperature before irradiation. In order to ascertain this effect and to gain a better insight into its nature, the dose-relationships were studied. Pupae were kept at +3°C or +35°C respectively for 6 h and were then irradiated with one of 6 x-ray doses between 100 and 1000 r. For each point of the dose-effect curves 375 000 scales were examined. The experiment was repeated once. The shape of the dose-effect curves for each mutation was the same, regardless of the kind of pre-treatment; but the level of the curves of the types ES1 and ES3 was considerably lower in the 3°C-series, whereas for ES2 and ES4 it remained the same or was even higher than in the 35°C-series. In consequence, the relative frequencies of the 4 types, i.e. the mutational spectra, were changed by different pre-treatments in the same proportion over the whole dose range tested.

1089 Muller, H.J., Oster, I.I., Zimmering, S. ARE CHRONIC AND ACUTE GAMMA IRRADIATION EQUALLY MUTAGENIC IN Drosophila? p.275-311 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Drosophila oögonia were irradiated with Co^{60} γ and the progeny studied for the appearance of sex-linked lethals. When doses and dose-rates were gaged by means of physical dosimetry alone it was found that a given dose induced about 1.6 times as many sex-linked recessive lethals in the immature oögonia of adult D. melanogaster, when they were irradiated at their lowest or dead level stage of sensitivity, if the radiation were delivered in the form of a single acute dose in about half a minute, at 44×10^{4} r/h, as it did if it were delivered in the form of a chronic dose extending over 2 weeks, at 12 r/h. Again using only physical dosimetry, doses of 4000 r delivered at lower rates, extending down to 1.5 r/h, gave no evidence of a further drop in the mutagenic effectiveness of the radiation. Still using only physical dosimetry, the results of 4000 r delivered at dose-rates measured as being in the range of 120 to 60 r/h showed good agreement with the results of the acute irradiation, and highly significant disagreement with those of the irradiation at 12 r/h and lower, when the irradiations in the 120 to 60 r/h range were carried out in the so-called hot room of the Brookhaven National Laboratories. On the contrary, when the irradiations in the 120 to 60 r/h range were carried out in the so-called dilution room, the observed frequencies of induced lethals showed good agreement with those obtained for 12 r/h and lower, and highly significant disagreement with those of the acute irradiation. A series of irradiations of spermatozoa in inseminated females was carried out in order to determine to what extent the frequencies of recessive sex-linked lethals induced in these well-studied stages corresponded with the expectations based on the physical dosimetry. It was found that the frequencies obtained from acute irradiation in the hot room, and also from chronic irradiation, at 12 r or less per hour, in the dilution room, were some 90% (± 5%) as high as expected for the supposed doses. In contrast to these results, the frequencies obtained from chronic irradiation at intended rates of either 60 or 12 r/h in the hot room were about 120% (± 5%) of those expected for the supposed doses. Application of correction factors for the doses used would remove all decisive differences in the per-r lethal frequencies. However, 12 r/h given in the hot room was reckoned by this method to have only half the mutagenic effectiveness shown by all these other treatments. A series of irradiations was thereupon carried out in which both spermatozoa in the female and oögonia were irradiated simultaneously. Most of the values directly observed for oögonia agreed satisfactorily with those obtained previously. However, after application of correction factors based on the results from the spermatozoa simultaneously given the same treatment, other values for oögonia were obtained. The 12 r/h irradiation in the hot room, giving a calculated lethal frequency of only 0.9%, appeared to be only about 0.4 as effective as the acute irradiation, and 0.7 as effective as chronic irradiation given in the dilution room. In an attempt to throw light on the discrepancy, as well as on lesser yet significant discrepancies in other cases, extensive tests were carried out of the possible influence of the following factors: delay in germ-cell maturation caused by irradiation or otherwise; natural differences in reproductive activity; differences in nutrition; presence or absence of a presumptive radioprotective agent (AET); exposure in center or near periphery of radiation field. None of the results indicated that any of these factors had affected the mutation frequency. (Auth.)

1090 Muller, H.J. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN Drosophila. (Abstr. B1F359). p.51 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

In order to throw light on the relative mutagenicity of chronic versus acute γ irradiation, the mutation frequency among offspring derived from eggs laid different lengths of time after irradiation of the female will be further investigated. Pre-imaginal and imaginal stages will be irradiated chronically and acutely, in a study of mutagenicity at these stages. Solutions of radionuclides will be used for delivering radiation at controlled rates. The effect of the pre-imaginal irradiations on survival and the life span of the exposed flies will also be studied, in order (among other things) to throw light on the influence of dose fractionation on the effectiveness of the radiation in producing damage of this kind. A series of other experiments designed to investigate the kinds of genetic basis underlying the damaging effects of x or γ radiation on survival and the life span will be carried out. These will involve the use of diverse specially constructed genetic stocks. The investigation of the question whether spermatozoa held in the male after irradiation undergo a natural pre-mutational repair, protracted over some 24 h, will be carried further. The study of the effect of anoxia (nitrogen) pre- and post-treatments on radiation mutagenesis will be carried further. Work will be continued on peculiarities of heterochromatin in undergoing radiation-induced structural changes.

1091 Murakami, A., Tazima, Y. MODIFICATION OF X-RAY INDUCED MUTATIONS IN Bombyx mori L. BY PRE- AND POST-IRRADIATION TREATMENT WITH 5-BROMOURACIL. A preliminary report. (Abstr.) Jap. J. Genet. 37 (1962) 400. (In Japanese)

1092 Nair, K.K., Subramanyam, G. EFFECTS OF VARIABLE DOSE-RATES ON RADIATION DAMAGE IN THE RUST-RED FLOUR BEETLE, Tribolium castaneum HERBST. p.425-9 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

In order to find out whether a change in dose-rate would significantly alter a radiation response, eggs as well as the adults of Tribolium castaneum were tested for viability and fertility respectively after exposure to γ-radiation at different dose-rates. The doses employed were 2000 and 5000 rad and the dose-rates ranged from 126 rad/h to 140 000 rad/h. It was observed that with an increase in dose-rate there was a decline in the fertility of the adults. Similarly the viability of the eggs was considerably reduced as the dose-rate increased, but at very high dose-rates there was a significant increase in viability. The significance of these findings is discussed. (Auth.)

1093 Nakanishi, Y.H., Makino, S., Ohnuki, Y. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION ON THE CELL, WITH SPECIAL REGARD TO THE BEHAVIOR OF THE CHROMOSOMES IN GRASSHOPPER SPERMATOCYTES IN RESPONSE TO X- AND BETA-IRRADIATIONS. p.115-35 in "Proceedings of the Symposium on Genetic Effect of Radiation, Mishima, 7-8 November 1960". Jap. J. Genet. 36, Suppl. The Genetics Society of Japan. 1961. (In English).

The major portion of the study was carried out on the 1st and 2nd spermatocytes of Podisma sapporense, supplementary data having been obtained from Chrysochraon japonicus, Chorthippus bicolor, and Oxya yezoensis. Results are given for (1) x-irradiation with whole body exposure (when chromosomes completed the equatorial arrangement in a seemingly regular manner but failed to separate or formed sticky bridges at anaphase); (2) β-irradiation of individual cells at selected stages (sensitivity was measured in terms of chromosome stickiness and found to decrease in order of diakinesis, metaphase and anaphase); and (3) β-irradiation of parts of individual cells. The need for further work is stressed.

1094 Nicoletti, B., Olivieri, G. INTERACTION OF X AND ULTRAVIOLET RADIATION IN PRODUCTION OF RECESSIVE LETHALS IN Drosophila melanogaster. Atti Ass. genet. ital. 7 (1962) 180-90. (In Italian, with English summary).

The possibility that uv rays given to different biological systems before or after x-rays could modify genetic or cytological effects is reviewed and discussed. Kaufmann and Hollaender's conclusions about the recovering effect of uv rays on chromosomal damage induced in Drosophila sperms by a pre-treatment of x-rays are discussed and analyzed taking into account some general considerations. Preliminary results of similar experiments on the frequency of sex-linked recessive lethals induced after single and combined x + uv treatments in Drosophila sperms are reported. All our experiments indicate no effect of the uv treatment (at the given wave lengths and doses) in lowering the frequency of the x-ray-induced recessive lethals. On the contrary, there are some indications for a synergistic action between the two radiations. These results not in agreement with the generally accepted theory that uv rays do recover x-ray-induced chromosomal damages, could be explained with the well established correlation between chromosomal rejoined breaks and genic mutations. (Auth.)

1095 Oberheuser, F., Künkel, H.A. ULTRAFRAKTIONIERUNG UND RELATIVE BIOLOGISCHE WIRKSAMKEIT SCHNELLER ELEKTRONEN. VERSUCHE AN Drosophila EMBRYONEN VERSCHIEDENER ENTWICKLUNGSSTADIEN. (Ultrafractionation and relative biological effectiveness of fast electrons. Experiments on Drosophila embryos at different stages of development). Biophysik 1 (1963) 11-19. (In German, with English summary).

A 15-MeV-betatron was used. By means of a special electronic device it was possible to quench radiation pulses in the injector of the accelerator. The frequency of radiation pulses thus varied between 2 and 50 pps. The ultra-fractionated radiation was compared with the continuous radiation from a 1000-c Co^{60}-source. The influence of ultrafractionation on the RBE of fast electrons was tested on Drosophila eggs aged 1¾, 4½, and 6 h (at least 2000 eggs being tested for each stage). The average dosage rate or the dose of the particular radiation pulses was kept constant. Dose-effect curves show a significant influence of the pulse frequency on the percentage of killed eggs, possibly due to the existence of a recovery effect.

1096 Oster, I.I. ON RECOVERY IN X-IRRADIATED GERM CELLS. J. cell. comp. Physiol. Suppl. 1 58 (1961) 203-7. Symposium on "Recovery of Cells from Injury, Gatlinburg, Tennessee, 3-6 April 1961". Philadelphia, The Wistar Institute of Anatomy and Biology. 1961.

After defining "recovery", the author suggests that spermatozoa located in different sections of the reproductive tract (male or female) are differently oxygenated. He proposes that differential radiosensitivity is in all likelihood responsible for differences which have been observed following x-irradiation of sperm. Some data is also given for irradiation with neutrons.

1097 Oster, I.I., Pooley, E., Schwarz, R. THE FREQUENCY OF MOSAIC MUTATIONS INDUCED BY GAMMA RAYS AND NEUTRONS. (Abstr.) Genetics 47, 8 (1962) 975.

Homogeneous samples of mature spermatozoa (from inseminated females) were treated with sparsely ionizing radiation (γ-rays from a Co^{60}-source) and densely ionizing radiation (fast neutrons) and the incidence and mode of expression of mutations induced at the dumpy locus were analyzed. A γ-dose of 4000 r (delivered at the rate of 200 000 r/h) yielded 64 mutations at the dumpy locus amongst 13 100 offspring (0.49%); 18 of these were mosaics (28%). A neutron dose of 750 rads yielded 52 mutations at the dumpy locus amongst 22 960 offspring (0.23%); 16 of these were mosaics (31%). These results resemble those obtained with x-rays (Carlson) but differ significantly from the 80-90% incidence of mosaics following treatment with chemical mutagens. Thus differences in LET do not result in different frequencies of induced mosaics, and unlike chemicals, ionizing radiation tends more often than not to affect both DNA strands while traversing the chromosome. In addition, preliminary results with x-irradiated spermatocytes and spermatids have indicated that although mosaics can be induced occasionally in these stages the frequency of such mosaics is similar to that produced by irradiation of spermatozoa. (From abstr.)

1098 Oster, I.I. THE MUTATIONAL SPECTRUM WITH SPECIAL REFERENCE TO THE INDUCTION OF MOSAICS. p.51-8 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

By the use of special multipurpose stocks of Drosophila melanogaster and refined breeding techniques the effects of several conditions existing at the time of irradiation were investigated. In addition to information gained concerning the frequencies of induced chromosome breakage, lethal mutations, and translocations, which were in line with previous results, it was found that γ-rays, x-rays in air or oxygen, and neutrons produce relatively low frequencies of mosaic mutations while irradiation under anoxic conditions results in fairly high proportions of mosaic individuals. (Auth.)

1099 Oster, I.I. MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. Annual Progress Report and Renewal Proposal for the Period September 1, 1962 to August 31, 1963. TID-16026, Institute for Cancer Research, Philadelphia. 1963. 13p.

Progress is reported in studies on the genetic effects of radiation in *Drosophila*. Such aspects as induced crossing over and non-disjunction, differences in the effects of acute and chronic irradiation, and effects of ionizing radiation of different LET transfer properties, delivered under various conditions, were studied. Several innovations and techniques are described that were introduced with a view to increasing the degree of refinement in the detection of induced hereditary changes.

1100 Oster, I.I. MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. Progress Report. 1 Sept. 1960-30 Nov. 1963. TID-19991, Institute for Cancer Research, Philadelphia. 1963. 29p.

An attempt was made to define the spectrum of effects that radiation of different LET properties (x, γ, fast neutrons) can produce in the genetic material of the fruit fly. Pre-imaginal stages and inseminated females proved the best source of homogeneous male germ cells. The relative sensitivity to γ-rays of spermatids in pupae and of spermatozoa in females was studied by a method similar to that used for determining the spectrum of sensitivity of germ cells to x-rays. A similar sensitivity to x- and γ-rays was obtained. Differences in mutation frequency among spermatozoa x-rayed in the female and in the male (but released on days following irradiation) appear due to differential oxygenation during treatment and hence to radiosensitivity rather than to recovery, supported by results obtained from neutron irradiation. Spermatids appear to be relatively less sensitive to neutrons than to x-rays. Results are also cited for various treatments (3000 r/min x-irradiation of spermatids, at the pupal stage in air: γ-irradiation of mature spermatozoa in inseminated females in 100% O_2; 100% N_2; 100% He; by fast neutrons in air). The LET difference between γ-rays and neutrons does not result in different frequencies of induced mosaics. The interactions between fast neutrons and x-rays were studied in mature spermatozoa. The effects appear to be additive for lethals but no interaction between breaks was observed. Work on (x-rays, fast neutrons) induced crossing-over are also described. Studies are under way to determine effects of varying radiation dosage, LET properties, and accessory conditions on non-disjunction in the female; and also on mutagen-induced mortality. Cytological observations are described.

1101 Oster, I.I. MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. (Abstr. B1E301) p.45 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

Experiments aimed at modifying the genetic damage produced by ionizing radiation will be continued using the reproductive cells of *Drosophila melanogaster.* Our studies on induced crossing-over and non-disjunction will be extended. Several new stocks will be utilized in order to pinpoint more exactly the regions of the chromosomes which are differentially affected as regards crossing over by different conditions existing during irradiation. In addition, experiments to determine the extent to which chronically-delivered radiation affects crossing over and non-disjunction will be undertaken. It is planned to extend our analyses of the effects produced by types of ionizing radiation characterized by different LET properties (i.e., γ-rays, x-rays and neutrons) in the genetic material when delivered at different doses and under different conditions. Special emphasis will be placed on determining the relative incidences of induced mosaic and whole-body mutations. The frequencies of such changes will also be studied following the exposure of germ cells to chronically-delivered radiation with a view to detecting the presence of repair mechanisms. In addition, with the aid of a newly developed cytological technique for studying somatic chromosomes we hope to be able to investigate the effects of relatively low doses of radiation, differences between acutely- and chronically-delivered radiation, and the effects of chemical mutagens.

1102 Paik, Y.K., Kim, T.S., Sung, K.C. PRELIMINARY REPORT ON THE EFFECT OF CYSTEINE ON THE RATE OF X-RAY INDUCED MUTATIONS IN *Drosophila melanogaster.* *J. nucl. Sci. 2* (1962) 37-40. (In English).

The protective effect of cysteine against the production of sex-linked recessive lethals in *Drosophila* sperm by x-irradiation was investigated. It is shown that the cysteine injection prior to irradiation apparently reduced the production of sex-linked recessive lethals. The protecting action of cysteine can be ascribed to the oxygen starvation produced by its easily oxidized-SH groups during irradiation. (NSA 17:1963, 35526)

1103 Pendlebury, J.B., Banham, E.J., Cooper, B.E., Bland, C.M. THE INFLUENCE OF TEMPERATURE UPON THE RADIATION SUSCEPTIBILITY OF *Sitophilus granarius* L. AERE-R-3641, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1962. 38p.

The factorial experiment was carried out to examine the effects of high and low temperatures (15°C and 30°C) before, during and after irradiation, on the susceptibility of the adult grain weevil to doses in the range 3000 to 20 000 rads. *Mortality:* A high temperature before irradiation sensitises the insect to subsequent irradiation, reflected in greater mortality, whereas a low temperature affords some protection. During irradiation these effects are reversed; a low temperature sensitises and a high temperature exerts a protective influence. Under both conditions the maximum effect is observed at doses between 3000 and 10 000 rads. After irradiation, a high temperature increases the rate of mortality; at low temperatures it is retarded, this last effect being independent of dose. *Sterility:* Differences of 15-30°C before, during and after irradiation do not modify the susceptibility of grain weevils to radiation sterilisation. The minimum dose for control of grain weevils (16 000 rads) would be effective at all temperatures likely to be encountered in commercial practice. (Auth.)

1104 Podolyan, V. Ya. PATHOGENIC EFFECT OF LOW AND MEDIUM DOSES OF GAMMA-RAYS ON THE PROGENY OF IRRADIATED INSECTS. *Trud. Inst. Zool., Akad. Nauk. Kaz. SSR 19* (1963) 220-5. (In Russian). English Translation: JPRS-22107.

Data are presented on the effects of low and medium doses of Co^{60} γ-radiation on adult spring carrion flies (*Protophormia terrae novae*) and on the progeny of these insects from the 1st to the 5th generation. Fifteen experiments used various radiation doses from 100 to 1500 r and combinations of irradiated males, irradiated females, or both irradiated males and females. The mortality rate among insects irradiated with 100 r was higher than that of mature insects exposed to higher doses. The percentage of unfertilized eggs and mortality rate of the pre-imaginal stages increased with the intensity of the radiation dose to the maternal generation of mature flies. Possible applications of radiation in the control of insect pests are discussed. (NSA 18:1963, 5010)

1105 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. FREQUENCY OF RECESSIVE SEX-LINKED LETHALS IN *Drosophila melanogaster* SPERMATOGENESIS, IN O_2, N_2, AND AIR, WITH 600 r AND 1200 r. *Drosophila Inf. Serv. 36* (1962) 111-2.

See 1107.

1106 Paulov, Š. EFFECT OF A LOW TEMPERATURE ON THE DEVELOPMENT OF RADIATION INJURY IN EGGS OF THE SILKWORM *Bombyx mori* L. *Folia biol., Prague 7* (1961) 281-4. (In English)

Experiments were made to determine whether the cooling of irradiated eggs during the diapause would moderate the effects of radiation in eggs of the silkworm. The degree of injury to the irradiated eggs was evaluated from the percentage of larvae hatched and from the time course of hatching. It was found that a low temperature moderated the effects of radiation. Injury was less when the eggs were irradiated before being placed in the refrigerator than when they were irradiated after being removed from the refrigerator. It is suggested that the difference in injury is related to metabolic changes. (NSA 15:1961, 30467)

1107 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. THE EFFECT OF X-RAY TREATMENT COMBINED WITH AIR, NITROGEN, OR OXYGEN IN *Drosophila melanogaster* STUDIED ON SEX-LINKED RECESSIVE LETHALS. *Atti Ass. genet. ital. 7* (1962) 170-9. (In Italian, with English summary).

Germ cells of spermatogenesis of *D. melanogaster* were treated with 600 r of x-rays. The sensitivity spectrum for recessive sex-linked lethals, obtained by crossing the treated males for 12 successive days, shows a maximum in days 5 to 7, corresponding to treated spermatids; this confirms data already known. Anoxia lowers the sensitivity throughout the whole spectrum, particularly for spermatids; O_2 treatment increases x-ray damage, although not uniformly in the different stages of spermatogenesis: the less sensitive cells under these circumstances are spermatids and spermatogonia. (Auth.)

1108 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. DIFFERENTIAL SENSITIVITY OF SPERMATOGENIC STAGES OF *Drosophila melanogaster* TO X-RAY IRRADIATION IN O_2 AND N_2. (Abstr.) p.187 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

By scoring recessive sex-linked lethals in repeated single matings of x-ray-treated *D. melanogaster* males to 3-Muller-5 females, with mating periods of 24h, a sensitivity spectrum is obtained for the different spermatogenic stages present in the testis at the moment of irradiation. With the aid of the sterility criterion and by comparison with other authors' data, it is possible to correlate the mutation frequencies with treated germ-cell stages. The results for the air treatment are in agreement with known data, giving a peak mutation frequency on the 6th day after treatment, corresponding to treated spermatids. If the flies are kept in an atmosphere of O_2 or N_2 from 45 min before to 45 min after irradiation, mutation frequencies in different cell stages are modified to a different extent. Anoxia, which shows a reducing effect on all stages, acts more strongly on stages giving highest mutation frequency in air. The effect of oxygen, on the other hand, is mainly restricted to mature stages utilized on days 1-4 after treatment, and to stages which we interpret as representing meiosis (7-10 d after treatment). Spermatids are least sensitive to an increase in O_2 concentration. A metabolic effect of the presence of different gases, as well as a different physiological content of O_2, could be responsible for the differential modifying action of O_2 and N_2 on the mutation frequency spectrum.

1109 Pozzi, L.V., Giavelli, S., Sironi, G.P., Callucci, E. DIFFERENTIAL SENSITIVITY OF SPERMATOGENETIC STAGES OF Drosophila melanogaster TO X-IRRADIATION IN O_2 AND N_2. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 380-1.

(Essentially as for 1108)

1110 Purdom, C.E., McSheehy, T.W. DOSE-RATE AND THE INDUCTION OF MUTATION IN Drosophila. Int. J. Rad. Biol. 7, 3 (1963) 265-75.

Drosophila male germ cells were exposed to 800 rad of Co^{60} γ-rays at 0.05, 0.5 and 5.0 rad/min. F_0 males were mated in 7 successive broods of which broods I and VII were sampled for IInd chromosome recessive lethal mutations. Mutation frequency was independent of dose-rate in each brood. It was concluded that dose-rate had no discernible effect on induced mutation frequency in spermatids (brood I) or spermatogonia (brood VII). These results are discussed in relation to the hypothesis that the dose-rate effect discovered by Russell in the mouse arose through repair of genetic radiation damage. It is suggested that killing of cells by radiation, which is much more extensive in the mouse than in Drosophila, would be a more plausible mechanism to explain the dose-rate effect than repair, for which there is no corroborative evidence. (Auth .)

1111 Purdom, C.E., McSheehy, T.W. RADIATION INTENSITY AND THE INDUCTION OF MUTATION IN Drosophila. Int. J. Rad. Biol. 3, 6 (1961) 579-86.

A study was made of the effect of intensity of irradiation on the production of IInd chromosome lethal mutations in spermatozoa and spermatogonia of Drosophila. No intensity effect was detected between x-ray doses of 3000 r given at 600 r/min and 2.0 r/min respectively, or Co^{60} γ-ray doses of 3000 r given at 2000 r/min and 2.0 r/min respectively. A comparison between the effect of Co^{60} γ-rays given at 2.0 r/min and 0.01 r/min at a total dose of 200 r showed that a slight intensity effect might be operative in spermatogonia but that this was very much less than that observed by Russell in the mouse over a comparable dose-rate range. (Auth.)

1112 Purdom, C.E. THE EFFECT OF INTENSITY AND FRACTIONATION ON RADIATION-INDUCED MUTATION IN Drosophila. p.219-30 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press, 1963.

The effect of radiation intensity on the induction of mutation was studied in Drosophila. Male germ cells were exposed to radiation intensities ranging from 0.01 to 2.6 r/min. No intensity effect was observed when irradiation was received primarily by spermatocytes and spermatids. Similarly, no intensity effect was observed in spermatogonia over the range 0.05 to 2.6 r/min. Irradiation at 0.01 r/min did, however, produce a significantly low mutation frequency in one experiment. This may indicate the presence, at very low dose-rates, of an intensity effect in spermatogonia, but the single observation was not regarded as conclusive. Attempts to examine the effect of dose-fractionation in the light of possible intensity effects were rendered inconclusive by the absence of an intensity effect in parallel experiments. (Auth.)

1113* Ray-Chaudhuri, S.P., Saha, A.K. PROTECTIVE ACTION OF VERSENE AGAINST RADIATION DAMAGE TO GRASSHOPPER CHROMOSOMES. Proc. nat. Inst. Sci., India 26B (1960) 6-10.

The effect of treatment with Versene (I) solution before irradiation on the frequency of chromosome breakage was determined by counting the number of dicentric bridges in the first meiotic anaphase divisions of the testes of the grasshopper, Gesonula punctifrons. In the controls (treated with 0.67% saline plus 86 r of x-rays), 10.8 ± 0.27 bridges were recorded as compared with 8.29 ± 0.61% in the treated series (10^{-3} M I in 0.67% saline plus 86 r of x-rays). The unirradiated I-treated group showed no bridges in 801 first anaphase cells. It was concluded that I is a definite though feeble protector of radiation-induced chromosome breaks in their material. (CA 56:1962, 789h)

1114 Ray-Chaudhuri, S.P., Chaudhuri, J.P., Chatterjee, S. CYSTEAMINE PROTECTION OF GRASSHOPPER CHROMOSOMES FROM X-RAY-INDUCED ABERRATIONS UNDER AEROBIC AND ANAEROBIC CONDITIONS. Int. J. Rad. Biol. 5, 6 (1962) 591-5.

The effect of cysteamine pre-treatment on the frequency of x-ray-induced chromosome aberrations was determined under both aerobic and anaerobic conditions by counting the dicentric bridges in the first division meiotic anaphase of the grasshopper, Gesonula punctifrons. Under aerobic conditions in the cysteamine-treated animals 20.73% bridges were scored as compared with 30-90% in the controls. Under anaerobic conditions the scores were 5.35% and 8.22% in the treated and controls, respectively. Thus the degree of protection by cysteamine under both aerobic and anaerobic conditions was found to be more or less the same. The possible mode of protection has been discussed. (Auth.)

1115 Reddi, O.S. THE GENETICAL RESPONSE OF RADIATION SPERMATOZOA TO DIFFERENT TYPES OF RADIATION TREATMENT. Int. J. Rad. Biol. 7, 3 (1963) 301-5.

Drosophila spermatozoa were exposed to x-rays in air, x-rays in N_2 and neutrons in air. Each treatment was given either to males or inseminated females. After x-irradiation in air the frequencies of sex-linked lethals and translocations were highest among the progeny of treated inseminated females, lower in the 1st day progeny of treated males, and lowest in the 2nd-day progeny of treated males. After x-irradiation in N_2 or after neutron radiation, all 3 frequencies were the same. This suggests that both differences (male versus female treatment; 1st versus 2nd day) have the same basic cause. Experiments in which x-rayed males were mated after 1 or 2 d of storage without females indicate that this cause is differential radiosensitivity between fully and nearly mature spermatozoa. (Auth.)

1116 Rinehart, R.R. SOME EFFECTS OF NITRIC OXIDE AND OXYGEN ON DOMINANT LETHAL PRODUCTION IN X-IRRADIATED Drosophila virilis MALES. Thesis. Texas Univ., Austin. 1962. 73p.

Drosophila virilis males were treated with various x-ray doses in the presence of small amounts of O_2, NO, or a combination of the gases. The effects upon sperm survival were tested at a warm temperature, 23-25°C, and at a cold temperature, 3-5°C. Control experiments were conducted in anoxia and in air at similar x-ray doses and temperatures. The treated males were matured for 5 d and then mated to 3 heterozygous females for successive 2-d mating periods. The number of eggs laid each day was recorded. Irradiation damage in males was enhanced approximately the same whether 1, 2, or 3% NO was used as the test-gas. This was true at either the 500 or 1000 r level of x-radiation. One atmosphere air, at 23-25°C, or 3% O_2, at 3-5°C, showed a similar amount of damage, with similar x-ray doses, as was observed when small amounts of NO were used. A lower temperature did not appear to alter the x-ray damage when the flies were treated with NO or anoxia. However, at 3-5°C irradiation damage was greatly enhanced when 3% O_2 was used as the test-gas. Flies were treated in a mixture of NO, O_2, and NO_2 prepared by mixing 3% NO and 3% O_2. Through hydrolysis of the NO_2, nitric and nitrous acids were presumably formed within the cell. At room temperature the amount of damage under these conditions was intermediate to that observed in the NO tests and tests conducted in anoxia. By lowering the temperature, the amount of damage was increased. The amount of lethality usually associated with 2 or 3% NO and 500 r was decreased if, immediately after irradiation in NO, the flies were post-treated with 1 atm. O_2. A 6-d period during which no eggs developed from females mated with males treated with 3% NO was due to a lack of mature sperm rather than to complete lethality. No definite conclusions were reached regarding mechanisms of enhancement of x-irradiation damage in males by NO. A number of experiments are pointed out that might resolve more completely the mode or modes of action of NO in the system. (Diss. Abstr., 23: 1962, 1839-40)

1117 Rinehart, R.R. SOME EFFECTS OF NITRIC OXIDE AND OXYGEN ON DOMINANT LETHAL PRODUCTION IN X-IRRADIATED Drosophila virilis MALES. Genetics 48, 12 (1963) 1673-82.

The ability of small amounts of NO or O_2 to increase dominant lethality was tested. (See 1116). It appears that when equal amounts of either NO or O_2 are present within the spermatogenic cells being tested, equal amounts of either gas cause equivalent increases in damage. In the presence of NO and O_2, which will react to form NO_2, much of the effect of both gases to increase x-ray damage was reversed. Neither NO nor its hydrolysis products, nitric or nitrous acid, appear to be the major mutagens in this system; O_2

post-treatment immediately after irradiation in 2% or 3% NO reverses some of the damage. NO appears to modify the post-irradiation survival of the males.

1118 Rudnicki, T. THE RELATIVE BIOLOGICAL EFFECT OF P^{32} β RADIATION. I. COMPARISON OF P^{32} β RADIATION AND X-RAYS AS TO THEIR BIOLOGICAL EFFECTS ON Drosophila melanogaster. Acta phys. polon. 12, 1 (1961) 154-7. (In Polish, with English and Russian summaries)

The influence of physical and biological factors on the biological efficiency of ionizing radiation was studied. The results of comparative studies on the biological effects of 70 kV x-rays and P^{32} β-radiation on D. melanogaster eggs 1 ± 1/4 and 3 ± 1/4 h old are given. No differences in biological effects were found between the 2 types of radiant energy. (Auth.)

1119 Sado, T. DIFFERENCES IN RESPONSE OF SILKWORM GONIA TO ACUTE AND CHRONIC γ-IRRADIATIONS. (Abstr.) Jap. J. Genet. 36 (1961) 393. (In Japanese)

1120 Sado, T. DIFFERENCES IN RESPONSE OF SILKWORM GONIA TO ACUTE AND CHRONIC γ-IRRADIATION. Annu. Rep. nat. Inst. Genet., Mishima. 1961 12 (1962) 90-1.

1121 Sävhagen, R. THE FREQUENCY OF XO MALES AND INDUCED AUTOSOMAL CROSSOVERS AFTER IRRADIATION OF Drosophila melanogaster MALES IN AIR OR COMMERCIAL NITROGEN. Hereditas 47 (1961) 23-42.

Results are reported from an investigation of the frequency of induced XO males and induced autosomal crossovers in meiotic and premeiotic stages in Drosophila after irradiation of 0 to 1-d-old males. The effect of irradiation under anoxia upon the yield of XO males and upon the rate of induced autosomal crossovers was also studied during the period of highest sensitivity to x-ray irradiation. By use of a dual-purpose stock it was possible to study both aberrations in the same stock. It is shown that there is a significantly lower rate of induced XO males in experiments performed under anaerobic conditions compared to those irradiated in air. It is furthermore obvious that the difference is most drastic in mating periods corresponding to the highest sensitivity. In order further to study the effect of irradiation under anaerobic conditions two experiments were performed where the dose was divided into two parts. The first part consisted of 1100 r in commercial nitrogen with an interval of 15 and 60 min, respectively, in air, whereupon the second part, 700 r in air, was given. The results indicate that there is some recovery after irradiation of the sensitive stages but that it could be only partly blocked by 700 r given in air within 15 min. That the reduced effect of irradiation under anoxia is not limited to XO males is obvious from the crossing-over study. The observed crossover data fit well with the sensitivity pattern obtained through XO studies. Spermatozoa available for insemination on and after the 12th day appear to correspond to cells treated as spermatogonia.

1122 Sävhagen, R. THE EFFECT OF OXYGEN CONCENTRATION ON THE FREQUENCY OF INDUCED XO MALES AND NON-DISJUNCTION FEMALES AFTER IRRADIATION OF Drosophila MALES. Hereditas 47 (1961) 163-89.

Studies were made on the effect of irradiation under different oxygen concentrations during various stages of spermatogenesis. Drosophila, 0-1 and 3-4 d old y^{16} and $sc^{8}Y$ males, were irradiated in commercial nitrogen or oxygen and mated to virgin y w sn females. A comparison between the yield of XO males after irradiation under anaerobic conditions and the corresponding data after treatment in air shows that a significantly lower rate of induced XO males is obtained after irradiation in N_2 atmosphere. The difference is most marked in mating periods corresponding to the period of highest sensitivity. The effect of commercial oxygen on the frequency of induced XO males after irradiation of 0-1 and 3-4 d old males is reversed as compared to the effect of air atmosphere. For 3-4 d old males irradiation in O_2 increases the yield of XO males. For both types of males almost no enhancing effect is obtained for mature spermatozoa after irradiation in O_2. It is concluded that it is not possible to talk about a common air/nitrogen ratio of radiosensitivity for irradiated Drosophila males, since there exists great variations between the different mating periods. For 3-4 d old males, irradiation under anoxia gives an almost total protection against induced non-disjunction. For 0-1 d old males a reduction in the yield of non-disjunction females is observed. The relation between radiosensitivity and intra and/or intercellular oxygen available in the treated cells is discussed. (From auth. summary)

1123 Schmid, W. THE EFFECT OF CARBON MONOXIDE AS A RESPIRATORY INHIBITOR ON THE PRODUCTION OF DOMINANT LETHAL MUTATIONS BY X-RAYS IN Drosophila. Genetics 46 (1961) 663-70.

Dominant lethal damage in immature germ cells of Drosophila virilis, obtained by x-radiation in CO, is drastically enhanced by the presence of very small amounts of oxygen. These small amounts of O_2 which would easily be removed by cellular respiration get access to the vicinity of the chromosomes if respiration in the cytoplasm is blocked. Post-treatment with CO + 5% O_2 for 9 h in the dark with the flies immobilized by the CO showed no effect on the x-ray-induced dominant lethal rate obtained from mature and immature stages of male germ cells. (Auth.)

1124 Seecof, R.L. TREATMENT OF EGGS FROM CARBON DIOXIDE SENSITIVE Drosophila WITH X-RAYS AND ULTRAVIOLET RADIATION. (Abstr.) Genetics 47, 8 (1962) 983.

Eggs were collected from females of a stabilized, CO_2-sensitive strain of Drosophila melanogaster, irradiated with x-rays or ultraviolet light, and permitted to develop into adult flies. The titer of the virus-like factor (sigma factor) causing the sensitivity was measured in these adults and compared to the titer in adults that developed from untreated eggs. Ultraviolet radiation from a germicidal lamp in doses of 200-600 ergs/mm^2 (mortality 15-40%) caused 4-8-fold increases in titer. Higher doses were not effective in raising titers. X-ray treatments in a range giving 20-70% mortality failed to cause measurable changes in titer. The titer increases following ultraviolet light treatment were significant in all of the 3 experiments done to date, but more elaborate control experiments are needed to establish the effect. Experiments are now being done to confirm the titer increases and to determine whether the titer increases represent an induction of infectious sigma from a noninfectious stage in the sigma life cycle.

1125 Shiomi, R., Tachibana, H. PROTECTIVE ACTION OF PENICILLIN AGAINST MUTAGENIC EFFECT OF X-RAYS IN Drosophila. (Abstr.) Jap. J. Genet. 37 (1962) 411-2. (In Japanese.)

1126 Shiomi, T. EFFECT OF PENICILLIN FEEDING ON THE REDUCTION OF RADIATION INDUCED MUTATION RATE IN Drosophila melanogaster. (Abstr. 5.46) p.71 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

A wild type D. melanogaster, Canton-S, was grown in a culture medium containing penicillin G (20 000 units per ml); 24 h old virgin males hatching from these cultures were irradiated with x-rays. The induced sex-linked recessive lethal mutations in mature sperms were tested by the Muller-5 method. X-ray doses used were 500, 1000, 2000, and 3000 r. The radiation induced mutation rates in penicillin-fed Drosophila are found to be about 1/2 of those for flies grown in normal culture conditions. The radiation dose-effect relationship remains linear. Penicillin containing medium lengthens the growth period of flies by nearly 1 d as compared to the normal culture, and the rate of emergence is higher than in the control. The feeding of penicillin during the first half of the larval stage is more effective in reducing the induced mutation rate than when fed during the 2nd half. The interpretation of this action of penicillin on the radiation induced mutations, especially its effect in the early stage of feeding, is difficult. (From abstr.)

1127 Sobels, F.H., Tates, A.D. RECOVERY FROM PREMUTATIONAL DAMAGE OF X-IRRADIATION IN Drosophila SPERMATOGENESIS. J. cell. comp. Physiol., 3 Suppl. 1 58 (1961) 189-96.

Data relating to repair processes in Drosophila males are summarized. The data suggest that repair from premutational damage is possible in at least 3 different stages of spermatogenesis, that is spermatids, meiotic stages, and late spermatogonia. Most data are available for stages characterized by peak sensitivity to x-irradiation, presumably consisting of spermatids and late spermatocytes. Here fractionation of the dose and pre-treatment with chloramphenicol lower the mutagenic effects of radiation, whereas post-treatment with N_2 results in an increase of radiation-mutagenicity. Post-treatment with cyanide may result in either an increase or a decrease of the mutation-frequency. As pointed out before, these observations can be explained by assuming that two processes with contrasting effects are involved in repair from premutational damage. Recovery seems to occur in dividing cells as meiotic stages and late spermatogonia where the mutagenic effect of radiation is reduced by pre-treatment with chloramphenicol and enhanced by anoxia, following radiation. In view of the present Drosophila data and other studies elsewhere the author considers the possibility of a uniform pattern to which repair-processes conform in dividing cells of widely divergent organisms. (From auth.)

1128 Sobels, F.H. THE ROLE OF OXYGEN IN RADIOSENSITIZATION BY CYANIDE IN Drosophila. Int. J. Rad. Biol. 3, 3 (1961) 328-9.

Male flies were pre-treated with HCN in O_2 or N_2 and irradiated in the respective gases. Sex-linked lethal tests were made for successive broods. Results in O_2 and in purified N_2 at low doses (590 r/min of x-rays) suggest that accumulation of O_2 plays a part in the enhancing effect of cyanide in spermatids after irradiation in air. The findings in impure and purified N_2 show that in the presence of a respiratory inhibitor even small amounts of O_2 may lead to a drastic increase in radiosensitivity. The fact that cyanide pre-treatment is effective in purified N_2 after high-intensity (2640 r/min) but not after low-intensity radiation is considered as an indication of a dose-rate effect specifically connected with cyanide pre- or post-treatment.

1129 Sobels, F.H. MODIFICATIONS OF THE MUTAGENIC EFFECT OF X-IRRADIATION IN Drosophila MALES BY CHLORAMPHENICOL AND RIBONUCLEASE. (Abstr.) p.121 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

It had been inferred that inhibition of protein synthesis favours repair of pre-mutational radiation damage (See 1131). This assumption is supported by the observation that both pre-treatment with ribonuclease, known for its inhibiting effect on protein synthesis, and post-treatment with chloramphenicol reduce the mutation frequency in comparison to that produced by x-irradiation alone. To explain the results it has been assumed that, from a certain amount of pre-mutational damage, a proportion does not result in mutation and that this repair process is restricted to a definite time-interval following exposure to radiation. The action of chloramphenicol and ribonuclease is thought to consist then in protracting the time-span available for repair of pre-mutational damage, which would result in a lowering of the mutation frequency. Further data relating to this interpretation will be reported. For all experiments, males carrying a closed-X chromosome were used. This restricts the genetic effects observed to point-mutational lethals and possibly small deletions.

1130 Sobels, F.H. DOSE RATE, CYANIDE, AND SOME OTHER FACTORS INFLUENCING REPAIR OF MUTATIONAL RADIATION DAMAGE IN Drosophila. Abh. dtsch. Akad. Wiss., Berl. Kl. Med. (1962) 115-3

In irradiated Drosophila spermatids and spermatocytes, repair processes were shown to occur in flies by treatment with cyanide. In the germ cell stages showing peak sensitivity to radiation, post-treatment with cyanide resulted in a significant increase of the mutation frequency, if x-irradiation was given at a high dose rate of 2200 r/min. Post-treatment following radiation at lower dose rates of 600 r/min or 150 r/min, however, did not notably change the frequency of mutation. Evidence was obtained that the increase in lethal frequency due to cyanide involves gene mutations and possibly small deletions. Cyanide may also inhibit a system reponsible for repair of part of the premutational radiation damage, and it was shown that cyanide can produce both enhancement and lowering of the mutation frequency induced by high-intensity radiation in spermatids. Pre-treatment experiments under conditions (N_2 or O_2), where cyanide is ineffective, if preceding low-intensity radiation, suggest that there is a specific dose rate dependence in the presence of cyanide. It was assumed that in the presence of cyanide high-intensity radiation, apart from direct damage to the chromosomes, affects a second susceptible system, which may be associated with repair processes. Other observations on modification of radioinduced frequencies after dose fractionation, post-treatment with N_2, and pre-treatment with both chloramphenicol and ribonuclease are reported. (NSA 17:1963, 24901)

1131 Sobels, F.H. MODIFICATION OF PRE-MUTATIONAL RADIATION DAMAGE IN Drosophila. p.197-212 in "Strahlenwirkung und Milieu (Radiation Effect and Milieu). Internationales Radiobiologisches Symposium in Montreux vom 28.Mai-3.Juni 1961". Sonderbände zur Strahlentherapie. Band 51. Fritz-Niggli, H., Ed. München, Urban & Schwarzenberg. 1962.

Changes of radiation-induced mutation frequencies in successive stages of spermatogenesis are reported after post-treatment with both HCN and N_2, after dose-fractionation and after pre-treatment with both chloramphenicol and ribonuclease. Except for the experiments with chloramphenicol and ribonuclease all exposures were given at a high dose rate of 45 r or 55 r/sec. Post-treatment with cyanide may lead to either an increase or a decrease of the mutation rate in stages with peak sensitivity. Post-treatment with purified N_2 increases the mutation frequency in spermatids, meiotic stages and spermatogonia (the last non-reproducible). Fractionation of the dose lowers the mutagenic effect of radiation in stages with peak sensitivity. Dose-fractionation followed by post-treatment with N_2 reduces the mutation frequency in spermatogonia. Pre-treatment with chloramphenicol decreases the mutation frequency in spermatids, spermatocytes and late spermatogonia, whereas an increase was observed in mature sperm. Pre-treatment with ribonuclease raises the mutation frequency in mature sperm and lowers it in spermatids. Modification of pre-mutational damage in Drosophila males is concluded to be possible in spermatids, meiotic stages and perhaps in spermatogonia. Two contrasting processes are postulated. The observations after pre-treatment with chloramphenicol and ribonuclease in sperm and spermatids suggest that protein synthesis is involved in the different radiosensitivities of these two stages. (From auth. summary)

1132 Sobels, F.H. RECOVERY FROM GENETIC RADIATION DAMAGE IN Drosophila. T.N.O.-Nieuws 17, 200 (1962) 574-7. (In Dutch).

1133 Sobels, F.H., Tates, A.D. EXPERIMENTS ON REPAIR OF PRE-MUTATIONAL RADIATION DAMAGE IN Drosophila. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 379.

Males carrying a ring-shaped X-chromosome ($X^{C2}yB$) were used throughout. This restricts the genetic effects observed to lethal point mutations and possibly small deletions. In one of the post-treatment experiments a reduction of the radiation-induced mutation-frequency due to chloramphenicol was observed throughout all stages, in another only in spermatogonia. In experiments on the effect of pre-treatment with ribonuclease, a significant decrease of the mutation-frequency was repeatedly observed in spermatids. The similarity in effect of ribonuclease with that of chloramphenicol suggests that inhibition of protein-synthesis can be held responsible for the reduction of the mutation-frequency, following pre-treatment with these substances. When the experiments on post-treatment with N_2 were continued, an increase of the mutation-frequency in spermatids of the post-treated group was consistently observed. A treatment-dealy experiment showed that the critical time-span during which modification of the mutation-process by N_2 is still possible, does not exceed 25 min. It has been assumed that from a certain amount of pre-mutational radiation damage, a proportion does not result in mutation and that this repair process is restricted to a definite time-interval. The increase of the mutation-frequency after post-treatment with N_2 is thought to result from an inhibition of the metabolic repair process. To explain the reduction of the mutation-frequency due to both pre- or post-treatment with chloramphenicol and pre-treatment with ribonuclease, it is assumed that inhibition of protein-synthesis increases the time-span available for repair of pre-mutational radiation damage. (From abstr.)

1134 Sobels, F.H. THE CONTRASTING EFFECTS OF OXYGEN AND NITROGEN IN DETERMINING INITIAL SENSITIVITY AND POST-RADIATION RECOVERY IN Drosophila SPERM AND SPERMATIDS. Int. J. Rad. Biol. 7, 5 (1963) 505.

Irradiation in O greatly restricts the capacity of the sperm or spermatids of Drosophila to undergo repair, as compared with irradiation in N. The O/N enhancement factor for irradiation-induced mutations was 1.3 for sperm and 3 for spermatids. (CA 61:1964, 7325_h-7326 a)

1135 Sobels, F.H. PEROXIDES AND THE INDUCTION OF MUTATIONS BY X-RAYS, ULTRAVIOLET, AND FORMALDEHYDE. Rad. Res., Suppl. 3 (1963) 171-83.

Results are reviewed from studies on the role of peroxides in the induction of mutations in Drosophila by x-rays, ultraviolet radiation, and formaldehyde. It is highly probable that the formation of either an organic peroxide or of free radicals including peroxidic and peracid radicals are involved in the production of mutations by formaldehyde and also perhaps in the radiosensitizing effect exerted by formaldehyde. This, then, seems at present the only possible experimental evidence that peroxides may be involved in the production of mutations by x-irradiation in Drosophila.

1136 Sobels, F.H. REPAIR AND DIFFERENTIAL RADIOSENSITIVITY IN DEVELOPING GERM CELLS OF Drosophila MALES. p.179-97 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

Pre-treatment of Drosophila germ cells with either chloramphenicol or ribonuclease was found to decrease the radioinduced frequencies of sex-linked lethals ($X^{C2}yB$ chromosome) in stages showing peak sensitivity to x-irradiation, corresponding to spermatids and late spermatocytes. In mature sperm these agents cause a significant increase of the mutation frequency. The results with spermatids suggest that inhibition of protein synthesis lowers the initial sensitivity to the induction of pre-mutational damage. Post-treatment with O_2, following radiation exposure to 3000 r in N_2, lowers the mutation-frequency. It is thought that, under these conditions, O_2 acts by activating an inhibited repair system. After exposure to 1000 r in O_2, the effect of post-treatment with O_2 exactly equalled that of post-treatment with N_2. This finding is interpreted on the assumption that the biochemical system responsible for repair, is damaged to a greater extent by irradiation in O_2 than in N_2. The observation that after exposure of a ring-X chromosome there is a dose rate dependence in the presence of cyanide and that dose fractionation produces fewer mutations in spermatids than unfractionated radiation, support the idea that the repair system itself is liable to undergo radiation damage. Post-treatment with chloramphenicol produced an enhancement of the mutation frequency in two experiments; so did streptomycin. These findings are taken as an indication that protein synthesis is required for the repair process. In other experiments, however, post-treatment with chloramphenicol lowered the mutation frequency. It was concluded that the mutational response in

Drosophila spermatids can be resolved into four components, which can be modified separately: initial radiosensitivity to the induction of pre-mutational damage, efficiency of the repair process, time of mutation fixation, radiation damage to the repair system. (NSA 18: 1964, 11887)

1137 Steger, J. M. EFFECT OF 2, 4-DINITROPHENOL ON IRRADIATION-INDUCED DOMINANT LETHALS FACTORS IN Drosophila melanogaster. Oncologia 15 (1962) 247-57.

The influence of 2, 4-dinitrophenol (I) on the radiation-induced rate of the dominant lethal factors of D. melanogaster was investigated. 72- and 96-h Larvae, whose testicles contain mainly spermatocytes, were given 1000 r of a 180 kv, 6 mA radiation. The descendants of irradiated males with non-irradiated females were examined regarding dominant lethal factors. The rate of dominant lethal factors was lowered by I from 82 to 71-6%, according to the I dose given before radiation. The protective effect of I could be due to a variety of intracellular processes, which have a partly mutation-stimulating, partly mutation-preventing effect. Of all factors, the hypoxia of the spermatocytes, caused by I during the irradiation, seems to have the largest effect. (CA 58: 1963, 4851h)

1138 Sumarukov, G. V. CORRELATION BETWEEN THE REDOX POTENTIAL OF THE LYMPH OF CRICKETS DURING IRRADIATION AND RADIOSENSITIVITY. (Abstr.) p. 95 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

A micromethod has been developed to determine the redox potential of the haemolymph of insects in vivo. The effect of various protective factors (hypoxia, protective substances) which influence the radiosensitivity of insects has been investigated. Uncorrelated differences in the values of the redox potential have been observed for solutions of protective substances and for tissues into which protective substances had been introduced. On the other hand, when protective substances are introduced into the organism during hypoxia, the values of the redox potential exactly correlate with the magnitude of the protective effect and radiosensitivity. The data reported in the literature which failed to show such correlation were obtained when the potential was measured in vitro and did not allow for the redistribution of the rates of oxidation-reduction reactions in living systems, altered by the protective effects.

1139 Сумаруков, Г. В. КОРРЕЛЯЦИЯ МЕЖДУ ВЕЛИЧИНОЙ ОКИСЛИТЕЛЬНО-ВОССТАНОВИТЕЛЬНОГО ПОТЕНЦИАЛА ГЕМОЛИМФЫ СВЕРЧКОВ И ИХ РАДИОЧУВСТВИТЕЛЬНОСТЬЮ. Радиобиология 2, 3 (1962) 374-7.

Sumarukov, G. V. CORRELATION BETWEEN THE VALUE OF THE OXIDATION-REDUCTION POTENTIAL OF THE HAEMOLYMPH OF CRICKETS AND THEIR RADIOSENSITIVITY. Radiobiology 2, 3 (1962) 58-62. Translation from Radiobiologiya 2, 3 (1962) 374-7.

It could be demonstrated that when crickets (Gryllus domesticus L.) were subjected to γ-radiation, cysteine and hypoxia had a cumulative protective effect. (Air was replaced by N_2 at the time of irradiation). The following LD_{50}-values were obtained: without protection - 4200 r; with free cysteine - 6750 r; with hypoxia - 9900 r; with cysteine and hypoxia - 11 900 r. A direct relationship was established between the in vivo value of the oxidation-reduction potential of cricket haemolymph and cricket radiosensitivity. A correlation was observed within the Eh range from +140 mV in unprotected crickets to -185 mV in crickets in N_2 after previous cysteine-injection. The relationship between radiosensitivity and the value of the oxidation-reduction potential of the tissues at the time of irradiation may be explained by the competition of various reducing agents (their concentration having increased under the influence of the protective factors) with the vitally important cellular reducing agents for oxidizing radicals and peroxides arising from irradiation.

1140 Tates, A. D., Sobels, F. H. THE GENETIC EFFECTS OF POST-RADIATION TREATMENT WITH CYANIDE IN PUPAL SPERMATIDS. Drosophila Inf. Serv. 35 (1961) 98-99.

1141 Tates, A. D., Sobels, F. H. MODIFICATION OF GENETIC RADIATION DAMAGE IN Drosophila BY POST-TREATMENT WITH NITROGEN AND FRACTIONATION OF THE DOSE. Int. J. Rad. Biol. 3, 5 (1961) 553-4.

Male flies with ring-shaped X-chromosome were exposed to a flow of purified N_2 during 25 min, following 1450 r (at 55 r/sec) of x-rays. Tests for sex-linked lethals were made in 5 successive 2-d broods, using 3 females/male/brood. In 2 independent experiments, a significant increase in the mutation frequency due to post-treatment was observed in the last 3 broods, representing stages with peak sensitivity and earlier stages (6. 7% lethals in 3357 chromosomes after radiation alone, and 9. 05% lethals in 3920 chromosomes in the post-treatment group, $\chi^2 = 13.29$). The effect of dose fraction was studied in 5 exposures, separated by 2 h of 1350 r (at 45 or 55 r/sec). In 2 out of 3 experiments, the mutation frequencies in stages with peak sensitivity were significantly ($\chi^2 = 11.04$) lower in the fractionated group (7. 2% lethals in 2694 chromosomes) than in flies after unfractionated dose (9. 8% for 2585). No such effects were seen in mature sperm and spermatogonia. With N_2 post-treatment, dose fractionation also resulted in a significant decrease in mutation frequency (9. 9% lethals in 2020 chromosomes for group in N^2, after unfractionated exposure, against 6. 0% in 2678 when 5 fractions were used; $\chi^2 = 7.38$). Repair of pre-mutational damage appears possible at peak sensitivity stages (presumably spermatids and late spermatocytes); fractionation lowers the mutagenic effects of high-intensity radiation, while post-treatment with N^2, like that with HCN (earlier) results in an increase of the radiation-induced mutation frequencies.

1142 Tates, A. D. MODIFICATION OF THE X-RAY INDUCED RATE OF SEX-LINKED LETHALS BY NITROGEN POST-TREATMENT AND FRACTIONATION OF THE DOSE IN Drosophila melanogaster. (Abstr. 5. 44) p. 70 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S. J., Ed. Oxford, Pergamon Press. 1963.

Results of 5 independent experiments* show a significant increase of mutation frequency due to post-treatment in spermatids and late spermatocytes, 9. 5% lethals (3744 tested chromosomes) were found after irradiation without post-treatment and 10. 8% lethals (5190 chromosomes) with N_2 post-treatment; normal deviate = 2. 21 and P = 0. 0139. A possible interpretation of the results is that N_2 post-treatment blocks repair of pre-mutational damage. In 2 experiments a 3rd group of flies received N_2 post-treatment after a delay of 25 min. A comparison of the results of delayed versus direct post-treatment shows a significant decrease of the mutation rate in the group with delayed post-treatment. The percentage for the direct treatment is 9. 54% (2222 chromosomes) and for the delayed treatment 7. 15% (2545 chromosomes); normal deviate 2. 538 and P = 0. 0055. This result suggests that in young spermatids and late spermatocytes repair, under these experimental conditions, is completed within 25 min. Five experiments were carried out to investigate whether dose fractionation favours repair. The mutagenic effects of a dose of 1350 r given in five equal fractions, separated by two hour-intervals, were compared with that of unfractionated irradiation. The results show a significant decrease of mutation frequency due to fractionation, in the same germ cell stages where N_2-post-treatment had been effective. Percentages of lethals for the fractionated and unfractionated groups are 8. 63% (4994 chromosomes) and 9. 77% (4676 chromosomes) respectively (normal deviate 3. 01 and P = 0. 0013).

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*[see 1141]

1143 Tazima, Y., Kondo, S., Sado, T. TWO TYPES OF DOSE-RATE DEPENDENCE ON RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. Genetics 46 (1961) 1335-45.

Dose-rate dependence of radiation-induced mutation rate was studied in silk-work spermatogonia and oögonia by the use of the specific locus method. Both sexes of a wild-type strain were exposed to x-rays, Cs^{137} γ-rays of high dose rate, or to Co^{60} γ-rays of low dose rate at a definite stage or during a definite period in early larval stages. The dose-rate ratios between the acute and chronic irradiations were 2500: 1; 1 to 7600: 1. The total doses given were 950 r or 1000 r. Two types of dose-rate dependence of radiation-induced mutation rate were found. In one type mutagenic effectiveness of chronic irradiation is lower than that of acute irradiation (Type I) and in the other mutagenic effectiveness is higher in chronic irradiation than acute irradiation (Type II). The former is observed only in the very young larval stage when the primordial germ cells are prevalent in the testis, while the latter is found when later stages of spermatogonia or oögonia are irradiated. For Type I dose-rate dependence, repair of primary mutations seems to be responsible, whereas for Type II dose-rate dependence selective killing of a specific type of cells by intense exposure seems to play an important role. The relationship between our finding and that of Russell is discussed. Radiation-induced mutation frequency is remarkably high at the very early stage of larva, i. e., around the time of hatching when the primordial germ cells are prevalent in the gonads. (Auth.)

1144 Tazima, Y., Kondo, S. DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES AND SELECTIVE KILLING. (Abstr.) Jap. J. Genet. 36 (1961) 395. (In Japanese).

1145 Tazima, Y., Kondo, S. FURTHER STUDIES ON TWO TYPES OF DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. Annu. Rep. nat. Inst. Genet., Mishima. 1961 12 (1962) 86-7.

1146 Tazima, Y., Kobayashi, T. COMPARISON OF ACUTE AND CHRONIC IRRADIATIONS IN RESPECT TO RADIATION-INDUCED LETHAL MUTATION RATES IN THE SILKWORM. Annu. Rep. nat. Inst. Genet., Mishima. 1961 12 (1962) 87-90.

1147 Tazima, Y., Kondo, S. FURTHER STUDIES ON DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OÖGONIA OF THE SILKWORM. (Abstr.) Jap. J. Genet. 37 (1962) 414. (In Japanese).

1148 Tazima, Y., Kondo, S., Sado, T. STUDIES ON THE GENETIC EFFECT OF RADIATION 1959-1960. II. STUDIES ON THE GENETIC EFFECT OF RADIATION WITH SILKWORM. (2) TWO TYPES OF DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATE IN SPERMATOGONIA AND OOGONIA OF THE SILKWORM. Nucl. Sci. Abstr., Japan 1, 3/4 (1962) 118. (In English).

See 1143

1149 Tazima, Y., Kondo, S. FURTHER STUDIES ON TWO TYPES OF DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION RATES IN SPERMATOGONIA AND OOGONIA OF THE SILKWORM. p. 7 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Two types of dose-rate dependence of radiation-induced mutation frequency have been found in early gonial cells of silkworm. In one type mutagenic effectiveness of chronic irradiation is lower than that of acute irradiation, and in the other the situation is completely reversed. The occurrence of either type depends upon the stage of germ cells. These findings have been interpreted by assuming differential repair for the former and selective killing for the latter (see 1143).
Further evidence compatible with the hypothesis of selective killing will be presented. Variation in induced mutation frequency was studied along with the development of germ cells both for the acute and chronic irradiation. It varied drastically after acute irradiation, being highest at the time of hatching and decreasing rapidly toward later stages, while it was almost constant after the chronic irradiation. Irradiation with various dose-rates in later stages revealed that the mutagenic effectiveness of radiation decreases gradually with increase in dose-rate within the range from 0.14 r/min to 320 r/min. In this stage mutation frequency for the acute did not deviate even at 150 r from a linear relation extrapolated from higher doses, suggesting that the delivered dose was too high to realize the expectation that a small dose of acute irradiation might give a higher frequency than expected from linear relation. Although directly supporting evidence is still meagre, there are two distinct types of dose-rate dependence, one of which cannot be interpreted by the repair hypothesis.

1150 Traut, H. DOSE-DEPENDENCE OF RADIATION-INDUCED MUTATION RATE IN Drosophila melanogaster DEPENDING ON THE STAGE SENSITIVITY OF THE IRRADIATED GERM CELLS. (Abstr.) p. 199 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Dose and stage dependence of radiation-induced mutation rate were investigated. Utilizing the dual-purpose strain constructed by Oster (1958) the dose-dependence of the frequency of x-ray-induced sex-linked lethals and II/III-translocations for several succeeding 1-d broods were studied, using 10 or 5 P-females per male, and irradiating 3-4-d-old Bar males (7 doses). With the co-operation of W. Ebeling, 174-h-old male pupae were also irradiated (5 doses). In addition, the dose dependence of lethals and translocations after irradiation of spermatozoa stored in inseminated females (9 doses) as well as of radiation-induced chromosome loss after irradiation of mature oöcytes (11 doses) were investigated. A stepwise increase of mutation rate with dose for almost all our dose-effect curves was found. For sex-linked lethals dose exponents > 1 for restricted dose regions were obtained. These results are discussed in relation to the following theoretical suppositions: approximation of a definite n-hit function by biological variability concerning hit number and formal target volume; 'mutation-by-breakage' hypothesis; and "position-effect" hypothesis. Special attention is paid to the departures (most of which are statistically significant) from the "classic" one-hit relation for sex-linked lethals. (From abstr.)

1151 Traut, H. DIE DOSISABHÄNGIGKEIT DER STRAHLENINDUZIERTEN MUTATIONSRATE BEI BERÜCKSICHTIGUNG DES REIFEGRADS DER KEIMZELLEN, UNTERSUCHT AN Drosophila melanogaster. (A study of dose-dependence of radiation-induced mutation rates in Drosophila melanogaster, allowing for the degree of maturity of the germ cells.) Thesis. Heidelberg, Germany. Universität. 1962 (In German).

1152 Traut, H. DOSE DEPENDENCE OF THE FREQUENCY OF RADIATION INDUCED RECESSIVE SEX-LINKED LETHALS IN Drosophila melanogaster. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 377.

Using the dual-purpose strain constructed by Oster, the dose-dependence of sex-linked lethals and translocations for the first 4 one-day-broods after irradiating 3-4 d old Bar-males was studied. Only the results on lethals are reported here. The ratio P-females: P-males was 10:1 or 5:1. Different doses of radiation were given from 1000 to 6000 r, using filtered x-rays at 150 kV. The lethal-curves are characterized (1) by dose-exponents > 1 restricted to certain dose-regions, (2) by a step-wise increase of lethal rate with dose. Most of the departures from linearity so obtained are statistically significant. The same is true for the results obtained by irradiating maximal sensitive germ-cells in male D. melanogaster-pupae, using low radiation doses, by Ebeling and Traut. (From abstr.) See also 1153.

1153 Traut, H. DOSE-DEPENDENCE OF THE FREQUENCY OF RADIATION-INDUCED RECESSIVE SEX-LINKED LETHALS IN Drosophila melanogaster, WITH SPECIAL CONSIDERATION OF THE STAGE SENSITIVITY OF THE IRRADIATED GERM CELLS. p. 359-74 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

In experiments showing a linear dose-effect relationship for sex-linked recessive lethals in Drosophila males, insufficient consideration has been given hitherto to the dependence of radiation sensitivity on cell stage. The effect of radiation dose on mutation frequency was subjected to a renewed study with emphasis on differential radiosensitivity. The following results were obtained: dose-exponents significantly greater than one for certain dose-ranges, indication of a stepwise increase of lethal rate with dose. Most of the departures from linearity thus obtained are statistically significant. Results are discussed in relation to the mutation by-breakage hypothesis and the problem of position-effect lethals. They seem to confirm Muller's suggestion that at relatively high doses, the linearity of the classical dose-effect curve for recessive sex-linked lethals is caused more or less incidentally by the counteraction of different factors. Furthermore, our findings support the calculations by Zimmer (1960) and Dittrich (1960) showing that curves of the one-hit type may not necessarily be the result of one-hit events alone, but also, of the biological variability of the irradiated material with respect to hit number and formal target volume. (Auth.)

1154* Ulrich, H. DIE BEZIEHUNG ZWISCHEN STRAHLENDOSIS UND MUTATIONSRATE BEI RÖNTGEN-BESTRAHLUNG VON Drosophila-ZYGOTEN. (The relationship between dosage and mutation rate in x-radiation of Drosophila zygotes). Rev. suisse Zool. 67 (1960) 287-95. (In German).

Zygotes (wild (females) X Muller 5 (males) were exposed to 200-1400 r. The reduction in number of males of the offspring of the radiated generation was taken as a measure of the rate of mutation in the Muller 5 X-chromosome to form a lethal recessive factor. The thus measured rate of mutation shows a linear relationship to dosage only if care is taken to maintain an optimum density of larvae in the culture tubes. Poor conditions resulting from under or overpopulation select against the larvae that are heterozygous for the lethal mutation, so that the measured mutation rate is less than the induced mutation rate. The possibility of such selection effects should be considered in all such mutation-rate experiments. (BA 36: 1961, 32829)

1155 Ulrich, H., Würgler, F.E. OXYGEN EFFECT IN NEWLY LAID Drosophila EGGS. (Abstr.) p. 187 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Eggs 15 ± 5 min after deposition were x-rayed. It has been shown that O_2 can be removed from such eggs within seconds by a N_2-current. Only a slightly greater number of eggs die during embryogenesis when treated for 7 min with a N_2-current, as compared with air-treated controls. It is therefore possible to analyze the O_2 effect with very short pre-treatment time and no lethal effects of anoxia. For the embryonic mortality and mutation rate (recessive lethals in the X-chromosome) the O_2 enhancement ratio was found to be between 2.0 and 2.5. Improvements in the egg-collecting procedure have made it possible to collect egg samples which are more homogeneous in age and thus in division stages. With these samples, of age variation of ± 1.5 min, the O_2 effect in relation to different division stages is being studied again. (From abstr.)

1156 Ulrich, H. PARTIAL IRRADIATION OF Drosophila ZYGOTES BY X-RAYS. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 381.

Fertilized eggs of D. melanogaster were x-irradiated totally 10 - 20 min after being laid, i.e. in different developmental stages before cleavage. Embryonic mortality as well as the rate of recessive lethal mutations in the X-chromosome (determined by testing the surviving female adults by a special Muller 5 technique) increases linearly with dose. The same is true when the uncleaved zygotes are irradiated in a N-current instead of air, when the N-values with all doses are only ~ ½ those for air. Eggs were also irradiated such that either the nucleus (the two pronuclei) in different division stages together with approximately the anterior half of the cytoplasm, or the posterior half of the cytoplasm without any nucleus, were treated. The effects of anterior-half irradiation are mainly the same as those of total treatment. Compared with these, the effects of posterior-half irradiation differ quantitatively and qualitatively. For instance, the dose-mortality curves differ in slope and shape. These and other differences demonstrate a much higher radiosensitivity and, thus, a much greater importance of the nucleus than of the cytoplasm in the killing effect of x-rays. Moreover, the differences indicate the existence of a specific x-ray effect on the cytoplasm. This effect cannot be detected in cases of total or anterior-half irradiation, since doses which would cause cytoplasmic damage would be considerably greater than the lethal dose for direct irradiation of the nucleus. However, in case of posterior-half irradiation with quite high doses, the cytoplasmic effect appears, but apparently together with other effects. After irradiation of the posterior half the embryonic mortality, for instance, could be due not only to a lethal effect on the cytoplasm itself, but also to scattered radiation energy reaching and damaging the shielded nucleus, and/or to an effect exerted on the nucleus by the irradiated cytoplasm (indirect radiation effect). The origin of sex-linked recessive lethals found after irradiation not only of total eggs or their anterior halves (direct irradiation of nucleus), but also of posterior halves (irradiation of cytoplasm only) are being investigated. (From abstr.)

1157* Ursprung, H. FRAGMENTIERUNGS- UND BESTRAHLUNGSVERSUCHE ZUR BESTIMMUNG VON DETERMINATIONSZUSTAND UND ANLAGEPLAN DER GENITALSCHEIBEN VON *Drosophila melanogaster.* (Experiments in fragmentation and irradiation for the assessment of the state of determination and the anlage pattern of the genital discs of *Drosophila melanogaster*). (TID-3098, no. 4209). *Roux Arch. EntwMech. Organ* *154*, 4 (1959) 504-58. (In German).

1158 Vatti, K.V. A STUDY OF THE SUCCESSIVE EFFECT OF ROENTGEN RAYS AND TEMPERATURE UPON THE FREQUENCY OF MUTATIONS AND ROENTGENOMORPHOSES. p. 189-93 in "Pervichnȳe Mekhanizmȳ Biologicheskogo Deĭstviya Ioniziruyushchikh Izlucheniĭ", Moscow, Publishing House of the Academy of Sciences. 1963. (In Russian).

Experimental evidence is brought forward on the successive effect of roentgen rays and temperature upon the mutation and morphoses frequency in *Drosophila.* It was shown that additional treatment with high temperature results in a considerable increase of the mutation and morphoses frequency exceeding the sum of the effects of these factors individually. The question is discussed of the presence after irradiation in the immature germ and somatic cells of a reversible state of increased sensitivity (after-effect) so that weak additional treatment greatly enhances the genetic and biological effect of irradiation. (Auth.)

1159 Wedvik, H., Strømnaes, Ø. THE EFFECT OF TEMPERATURE DURING IRRADIATION ON THE BROOD-PATTERN OF DOMINANT LETHALS INDUCED IN *Drosophila melanogaster* SPERM. *Int. J. Rad. Biol.* *7*, 4 (1963) 369-75.

Four sets of males were exposed for half an hour to either 22°C, 7°C, 4°C or 0°C and then mated to a new set of 5 virgin females on each day for 14 d. The first sterile males appeared on day 4 in the series exposed to 22°C or 7°C, and the number of sterile males increased at almost the same rate on later days in the two series. In the series exposed to 4°C and 0°C, the sterile males appeared already on the second day after exposure and increased on later days with a significantly higher rate than in the two previous series. The highest number of sterile males on each day is found in the series exposed to 0°C. Whether the males have been exposed to 22°C, 7°C, 4°C or 0°C does not seem to influence the fecundity of the fertile males, or the hatchability of eggs fertilized by sperm from these males. Males exposed to 7°C during irradiation with 1000 r of x-rays exhibit a significantly higher frequency of dominant lethals than males irradiated at 22°C for all broods from the 1st to the 7th after treatment, but the data for later broods indicate no difference between the two series. (Auth.)

1160 Wharton, D.R.A., Wharton, M.L. EFFECT OF β-MERCAPTOETHYLAMINE (MEA) ON THE RADIOSENSITIVITY OF THE MALE COCKROACH, *Periplaneta americana* (L.). *Rad. Res.* *16* (1962) 723-7.

No increased resistance to radiation (10 000 rads) from a 2-MeV Van de Graaff accelerator was observed after the injection or ingestion of various toxic or non-toxic concentrations of MEA. Although the toxicity of ingested MEA attained a high level of lethality during several weeks of feeding, it was quickly lost on denial of MEA to the roaches. It is suggested that the dose of MEA that would be required to counteract the lethal dose of radiation would itself be too toxic to demonstrate protection.

1161 Whiting, A.R. TEMPERATURE EFFECTS ON LETHAL MUTATION RATES OF *Habrobracon* OÖCYTES X-IRRADIATED IN FIRST MEIOTIC METAPHASE. *Genetics* *46* (1961) 811-6.

Unmated females of *Habrobracon* were irradiated with 1263 and 1444 r at high and low temperature before, during, and/or after irradiation. A significant lowering of lethal changes induced in oöcytes x-irradiated in first meiotic metaphase (LD 50 about 400 r) at low temperatures before and after exposure as measured by hatchability of unfertilized eggs was observed. Low temperature during irradiation (1½ - 2 min) did not significantly change survival rate although there is a suggestion of a tendency toward increased lethality. Theories are discussed as to the cause or causes of differential sensitivity of cells and the relation of the sensitivity to O_2 and temperature. (Auth.)

1162 Wind, H., Traut, H. ZUR SAUERSTOFFABHÄNGIGKEIT DER RATE STRAHLENINDUZIERTER CHROMOSOMENABERRATIONEN IN OOZYTEN VON *Drosophila melanogaster.* (The influence of oxygen on the frequency of radiation-induced chromosome aberrations in oöcytes of *Drosophila melanogaster.*) *Z. VererbLehre* 92 (1961) 34-7. (In German).

Abrahamson's results concerning the influence of oxygen on the frequency of x-ray induced structural changes (half-translocations) in *Drosophila* oöcytes were generally reproduced, especially the demonstration of a "reverse" oxygen effect (under special experimental conditions protecting action of O_2, sensitization by N_2). The added aberration frequencies of the 3rd and 4th day after the various treatments generally tended to decrease as compared with those of the first 2 days (dependence on state of maturity of the treated oöcytes). Preirradiation treatment by N_2 increased the aberration frequency significantly. Possible explanations of this effect are discussed. (Auth.)

1163 Zakharov, I.A., Inge-Vechtomov, S.G. THE EFFECT OF ROENTGEN RAYS AND OF HIGH TEMPERATURE UPON THE CROSSING OVER PROCESS. p. 194-7 in "Pervichnȳe Mekhanizmy Biologicheskogo Deistviya Ioniziruyushchikh Izluchenii". Moscow, Publishing House of the Academy of Sciences, 1963. (In Russian).

A comparative study of the effect of x-rays and of high temperature upon the crossing-over frequency in the centromere region of chromosome III of *Drosophila melanogaster* females showed that these agents call forth crossing-over at different stages of oögenesis. High temperature proved to be a factor specific only to one stage, presumably the moment of chromosome conjugation (pro-phase of the first maturation division), whereas x-rays induce crossovers in cells both in the prophase of the first division and in the preceding stages. It is suggested that x-rays call forth some changes in the chromosomes of the oögonia that convert into chromosome exchanges when the cells reach the prophase stage of the maturation division. High temperature and x-rays act independently of one another. (Auth.)

See also:

479 Cytogenetic studies of x-ray and ingested P^{32} induced sex-linked recessive lethals in *Drosophila melanogaster.* (Walen, 1962)
753 Ionizing radiations and the induction of chromosome mutations in the germ cells. (Ray-Chaudhuri, 1961)
757 Dependence of the frequency of occurrence of dominant lethal mutations in the spermatids of *Drosophila* upon dose of irradiation with fast neutrons. (Abeleva and Lapkin, 1963)
758 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. Progress Report, May 1, 1958-April 30, 1959. (Alexander, 1959)
759 Ibid. Progress Report, May 1, 1959-April 30, 1960. (Alexander, 1960)
760 Ibid. Progress Report, May 1, 1960-April 30, 1961. (Alexander, 1961)
767 Induction of nuclear damage by ionizing and ultra-violet radiation. (von Borstel, 1961)
768 A comparison of the susceptibility of the grain weevil (*Sitophilus granarius* L.) to accelerated electrons and ^{60}Co gamma radiation. (Bull *et al.*, 1961)
776 The induction of dominant lethal mutations in x-irradiated *Drosophila virilis* oöcytes. (Dickerman, 1962)
777 Induction of dominant lethal mutations in x-irradiated *Drosophila virilis* oöcytes. (Dickerman, 1963)
785 The response of *Drosophila* testis to x-ray induction of dominant lethals. (Hoenigsberg *et al.*, 1961)
787 Genetic and direct effects of gamma radiation on *Drosophila.* (Ives, 1963)
796 The effect of neutrons and x-rays on the fertility of *Tribolium confusum.* (McDonald, 1961)
803 Appearance of dominant lethal mutations in *Drosophila melanogaster* during cosmic flight on ship-satellite. (Parfenov, n.d.)
810 Action des rayons γ sur la stérilité d'une noctuelle du coton (genre *Laphygma exigua*). (Rasulov, 1963)

824 The role of recovery mechanism and oxygen effects upon changes in radiation sensitivity in sperm treated in mature males and fertilized females of Drosophila. (Alexander, 1962)

827 The effect of radiation dose rate upon the production of eye color mutations in the chalcid Dahlbominus. (Baldwin, 1961)

828 The effect of radiation dose rate on the production of eye colour mutations in the chalcid Dahlbominus. (Baldwin, 1961)

829 Dose rate effects on the yield of radiation-induced eye colour mutations in an insect. (Baldwin, 1963)

830 Radiobiologic studies with Drosophila. (Baxter, 1963)

841 The frequency-dose relation of x-ray-induced Y-suppressed lethals in Drosophila. (Edington et al., 1962)

854 The action of radiation and other mutagenic agents (1) in inducing mutation in Drosophila females, and (2) in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, 1961)

855 Ibid. Report Covering 9-Year Period, May 1, 1953-April 30, 1962. (Glass, 1962)

857 Effect of fractionation of the gamma-ray dose upon the frequency of occurrence of mutations in spermatids of Drosophila melanogaster. (Glembotskiĭ et al., 1961)

859 The effect of small doses of ionizing radiation on the frequency of occurrence of sex-linked, recessive, lethal mutations of Drosophila. (Glembotskiĭ et al., 1963)

863 Cytological effects of x-rays in relation to dose-rate in Drosophila melanogaster. (Gunson, 1962)

874 The influence of radiation in altering the incidence of mutations in Drosophila. (Indiana Univ. Foundation. Research Div., Bloomington. 1962)

880 Radiation induced viability mutations in the honey bee. (Lee, 1962)

895 Dose-rate and the induction of mutations in Drosophila. (Purdom and McSheehy, 1963)

918 Chromosome rearrangements induced by x-rays in immature germ cells of Drosophila. (Abrahamson, 1961)

950 Can Drosophila spermatozoa be used in studies of recovery processes? (Lüning, 1961)

962 Dose-effect relation in the induction of crossing-over with x-rays in males of Drosophila melanogaster. (Olivieri and Olivieri, 1963)

963 Induction of crossing-over in Drosophila melanogaster males with various doses and fractionated doses of x-rays. (Olivieri and Olivieri, 1963)

964 Induced crossing-over in males of D. melanogaster. (Olivieri and Olivieri, 1963)

967 The effect of accessory conditions on x-ray induced non-disjunction in Drosophila. (Oster and Pooley, 1963)

968 The genetic basis of somatic damage produced by radiation in third instar larvae of Drosophila melanogaster. (Ostertag, 1961)

970 Induction of chromosome aberrations in the spermatocytes of grasshoppers. (Ray-Chaudhuri, 1961)

979 The linear dose-dependence of radiation-induced translocation frequency in Drosophila melanogaster at relatively low x-radiation doses. (Traut, 1963)

990 The grasshopper neuroblast culture technique and its value in radiobiological studies. (Carlson, 1961)

1019 Cell stages and differential sensitivity to irradiation in males of Drosophila melanogaster. (Sävhagen, 1963)

1020 Differential susceptibility of sperm and spermatids to ionizing radiations. (Schmid, 1961)

1025 Differential radiation-sensitivity of germ cells as a possible interpretation of sex difference in dose-rate dependence of induced mutation rates in the silkworm. (Tazima and Kondo, 1963)

1166 Recovery from radiation and chemically induced premutational damage. (Brink, 1962)

1181 Mechanism of resistance to virus diseases in the silkworm Bombyx mori (IV) (V) (VI). (Aruga, 1958)

1182 Studies on the induction of nuclear and cytoplasmic polyhedroses by treating with x-rays and ultraviolet light in the silkworm, Bombyx mori L. (Aruga and Yoshitake, 1961)

1183 15. Induction of virus infections. 2. Ultraviolet light and x rays. (Aruga, 1963)

1190 Radiation effects on the cytoplasm of Habrobracon eggs. (Kenworthy, 1962)

1205 The action of tumorigenic treatments and protective agents on melanotic tumour formation in D. melanogaster. (Burnet, 1963)

1222 Effects of radiations on insects. (LaChance, 1962)

1258 The effect of irradiation with γ-ray: Co^{60} on the development and reproductive power of Trombicula akamushi var. deliensis. (Hsu et al., 1963)

1271 The influence of age and mating patterns before and after irradiation on the incidence of induced mutations in Drosophila melanogaster. (Lefevre, 1963)

1273 Investigations of radiosensitivity during spermiogenesis in Drosophila melanogaster. (Mossige, 1963)

1277 Radiosensitivity of Drosophila spermatogonia. (Oftedal, 1962)

1281 The effect of γ-rays on eggs of Ephestia kuehniella Zell. (Pelerents and Brande, 1961)

1325 The modification by x-irradiation of the life span of haploids and diploids of the wasp, Habrobracon sp. (Clark and Rubin, 1961)

1326 Life span differences between haploid and diploid males of Habrobracon serinopae after exposure as adults to x rays. (Clark et al., 1963)

1374 Reactions to X-rays of a normal and a HCN-unsusceptible stock of Drosophila melanogaster. (Lüers, 1963)

1385 Research in genetics. (Stone, 1963)

1447 Laboratory studies on the use of irradiated sterile males to reduce C. fatigans Wied. populations. (Ramakrishnan et al., 1962)

I-A-7 RADIATION AND MUTAGENIC CHEMICALS: COMPARISON OF EFFECTS

1164* Bettendorf, G., Maass, H., Kirsten, E., Künkel, H. A. THE EFFECTS OF X-RAYS AND CYTOSTATICS ON THE MUTATION RATE IN Drosophila. Strahlentherapie 112 (1960) 74-8 (In German).

By means of the combined application of ionizing rays and the chemical mutagenic substance 2, 5-bisethyleneiminobenzoquinone-1, 4 (BBC) the degree of genetic effect on Drosophila was studied. The application of the mutagenic agents in the sequence of BBC + x-ray irradiation caused the addition of the different mutagenic effects, whereas the same treatment in the order of x-ray irradiation + BBC resulted in a considerably reduced yield of mutations. (Auth.)

1165 Borstel, R. C. von, Löbbecke, E. A. CELL KILLING AND THE PROBLEM OF NUCLEAR REACTIVATION. (Abstr.) p. 240 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

X-irradiation kills gametes and gonial cells of the wasp Habrobracon by several means: (1) mitotic rate depression, concurrent, for the most part, with chromosome bridge formation; (2) genetic death through deletion of blocks of essential genes; (3) genetic death through drastic loss of chromosomes or their parts; (4) immediate death of early oöcytes or very late gonia before any cell division occurs; and (5) death very late in embryonic development after irradiation of oögonial cells. UV-radiation and nitrogen mustard kill mature Habrobracon oöcytes principally through depression of mitotic rate; only a low frequency of deaths are of the gene-loss types. Nitrogen mustard also apparently is capable of inducing Type (4), immediate cell death, a type that cannot be tested with UV-radiation in our system. The mitotic inhibition induced by x-radiation can be reversed only to a limited degree by fertilizing an irradiated egg with an unirradiated sperm. Partial nuclear reactivation of mitotically inhibited cells appears to occur in most of the embryos exposed as oöcytes to either UV radiation or nitrogen mustard. It would appear that the mechanism of mitotic rate depression is different between x-radiation, UV and nitrogen mustard. Supporting this contention, nitrogen mustard induces chromosome bridges at a very low frequency at doses where lethality is induced.

1166 Brink, N. G. RECOVERY FROM RADIATION AND CHEMICALLY INDUCED PREMUTATIONAL DAMAGE. Papers Proc. roy. Soc., Tasmania 96 (1962) 41-7.

The question of recovery from radiation and chemically induced premutational damage is discussed in relation to the nature of the primary genetic damage at the molecular level, and also in relation to factors which influence the recovery process. Includes studies on Drosophila and broad-beans.

1167 Browning, L. S., Altenburg, E. THE CORRELATION OF THE RATIO OF LETHAL TO VISIBLE MUTATIONS WITH THAT OF WHOLE-BODY TO FRACTIONALS INDUCED BY X-RAYS AND CHEMICAL MUTAGENS. (Abstr.) Genetics 46, 8 (1961) 855.

In experiments designed to test the relative rates of lethal and visible mutations induced by x-rays and chemical mutagens (using Muller's Maxy technique) as well as the relative proportion of whole-body and fractional mutations among the visibles, it was found that in the x-ray series, the ratio of lethals to visibles was much higher than in the case of the chemical mutagens: 78.1 lethals: 1 visible after treatment of the adult males with 3000 r versus 8.7 lethals: 1 visible for dimethyl myleran, 12.9:1 for phenylalanine mustard, and 19.9:1 for ethyleneiminohydroquinone. However, these proportions of lethals to visibles were directly correlated with the ratio of whole-body mutations (visibles) to fractionals, being highest for x-rays (113:9 in 159 000 tested chromosomes), lowest for dimethyl myleran (13:26 in

17 000 chromosomes), next lowest for phenylalanine mustard (11:12 in 24 000 chromosomes), and next for ethyleneiminohydroquinone (21:9 in 31 000 chromosomes). It is concluded (as suggested by Carlson and Oster) that gonadal lethal mosaics account in large measure for the relatively low rate of detected lethals to visibles in the chemical series, a conclusion in agreement with the earlier work of Auerbach showing that gonadal mosaicism is higher under chemical treatment than under x-rays. (Larger scale tests by us are in progress, similar to those of Auerbach). The present experiments further indicate that the ratio of fractionals to whole-body mutations induced by x-rays is somewhat dose-dependent, being higher for 5000 r (18:95 in 4900 tested chromosomes) than for 3000 r (9:113 in 7700 tested chromosomes). In terms of Muller and Carlson's "rotational substitution" theory, this result might indicate that the higher dose (5000 r) might have caused a relatively higher proportion of breakage of base pairs into single bases with a resultant lower proportion of "rotational substitutions" of the intact base pairs and relatively more single base substitutions.

1168 Browning, L.S., Altenburg, E. GONADAL MOSAICISM AS A FACTOR IN DETERMINING THE RATIO OF VISIBLE TO LETHAL MUTATIONS IN Drosophila. Genetics 46 (1961) 1317-21.

The higher the proportion of fractional mutations relative to whole-body produced by treatment of post-meiotic germ cells of the mature Drosophila male with four mutagenic agents, the higher is the ratio of visible mutations to detected recessive lethal mutations. The relative rates are as follows (where % of fractionals is followed by the ratio of visibles to lethals in parentheses): 3000 r x-rays, 7% (1:80); 2, 5 bis-ethyleneiminohydroquinone, 30% (1:20); phenylalanine mustard, 52% (1:13); dimethyl myleran, 67% (1:9). This correlation might be explained (as suggested by Carlson and Oster, Rec. Gen. Soc. Amer. 30:1961, 66) on the assumption that gonadal mosaicism would lead to a lowering in the percent of detected lethals, since a gonad which was partly normal (and partly lethal) would appear on further testing to be nonlethal. However, the recovered visible rate would not be similarly depressed by gonadal mosaicism, since visible fractionals would be phenotypically evident. These results necessitate a reappraisal of the claim that chemical mutagens are specific for visible loci in Drosophila. (Auth. summary)

1169 Cantwell, G.E., Henneberry, T.J. THE EFFECTS OF GAMMA RADIATION AND APHOLATE ON THE REPRODUCTIVE TISSUES OF Drosophila melanogaster Meigen. J. Insect Path. 5 (1963) 251-64.

Adult flies were treated with apholate or γ-rays to determine their effects on reproductive tissues. Male and female flies 3 to 4 d old were exposed to 8 or 16 kr of Co^{60} radiation at a rate of ~320 r/min or were fed 0.25 or 1% apholate in the diet. Ovaries and testes were removed at daily intervals for microscopic examination. With the higher doses of either treatment, cessation of sperm production occurred in the anterior end of the testes after the 8th day, with a general necrosis of the germinal epithelium in that area. The necrosis progressed until the 19th day when few sperm were observed in the testes of treated males. The ovaries from treated females were reduced in size, and with the high dose of each treatment this noticeable change occurred 2 d following treatment and became more prominent until the 10th day when very little ovarian tissue remained. Very small Feulgen-positive clumps of chromatin indicated that complete breakdown of the nurse cells, oöcytes, and follicle cells had occurred in ovarioles. Untreated females mated to males either fed 1% apholate or exposed to 16 kr deposited a large number of eggs, none of which hatched. Since fertilization precedes egg laying in D. melanogaster, it was evident from the egg production data and microscopic examination that sperm transfer was not halted by the levels of either treatment used. Some adults emerged from eggs deposited by untreated females mated to males fed 0.25% apholate or exposed to 8-kr radiation, indicating that the treatments caused development of a lethal factor in some of the sperm which fertilized eggs. No adults emerged from eggs fertilized by males treated with high doses of either treatment which induced lethality in all sperm which fertilized eggs. No eggs were deposited from females irradiated with 16 kr and mated to untreated males and none were deposited after the 2nd day from females fed 1% apholate and mated to untreated males. No adults emerged from the few eggs deposited, corroborating the histopathological investigation, which showed pycnosis and Feulgen-positive chromatin clumps and ovarian atrophy soon after treatment. Females fed 0.25% apholate or exposed to 8 kr and mated to untreated males produced few eggs but some adults emerged. (NSA 18: 1964, 1400)

1170 Carlson, E.A., Oster, I.I. COMPARATIVE MUTAGENESIS OF THE DUMPY LOCUS IN Drosophila melanogaster. II. MUTATIONAL MOSAICISM INDUCED WITHOUT APPARENT BREAKAGE BY A MONOFUNCTIONAL ALKYLATING AGENT. Genetics 47 (1962) 561-76.

Monofunctional quinacrine mustard (ICR 100) induces mutations at the dumpy locus with an average frequency of 0.88%. More than 90% of the recovered dumpy mutations are distributed mosaically in somatic and gonadal tissues. Mutation frequencies at 16 other loci expressing visible effects were low or negligible. These experiments suggest that x-ray-induced mosaic mutations become established primarily at the first synchronous nuclear division of the zygote and that the ICR 100-induced mosaic mutations become established primarily at a later replication. Sex-linked lethals scored in the F$_2$ occur with a frequency of 3.7%; mosaic sex-linked lethals detected by scoring in the F$_3$ occur with a frequency of 13.7%. The mutational spectrum of the dumpy alleles induced by x-rays does not differ appreciably from that induced by the ICR 100. ICR 100 is capable of inducing mutations in spermatoza, spermatids, and the earlier stages of meiosis, including spermatogonia. No evidence for breakage events at the dumpy locus was detected in the progeny derived from ICR 100-treated sperm. The use of the sex-linked lethal test as ordinarily applied, i.e. by examination only of the F$_2$ generation, for determining the effectiveness of a chemical mutagen or for equating an equivalent roentgen dose to various concentrations of chemical mutagen can be misleading. However, the test can be made more meaningful by continuing the analysis for another generation and/or combining it with a test for visible mutations at specific loci. (Auth.)

1171 Caspari, E.W. SOMATIC MUTATIONS IN THE MOTH Ephestia. PROGRESS REPORT. TID-19166, Rochester, N.Y. Univ. Coll. of Arts and Science. Aug. 1963. 25p.

The scales on the hind wing of the moth Ephestia were used as an example of a developing and differentiating system in studies of the effects of x-radiation and chemical mutagens on the genetic structure of developing cells. The chemical mutagens used included 5-bromodesoxyuridine (5-BDU), 5-bromouracil, 2-aminopurine, and 5-BDU plus thymidine. Very little effect was observed after treatment with 2-aminopurine and 5-bromouracil. Possible reaction mechanisms involved in the genetic action of 5-BDU and x-radiation are discussed. (NSA 17: 1963, 31856)

1172 Henneberry, T.J., Cantwell, G.E. SOME EFFECTS OF GAMMA RADIATION AND APHOLATE ON THE REPRODUCTIVE TISSUE OF Drosophila melanogaster. (Abstr. 274) Bull. ent. Soc. Amer. 8, 3 (1962) 166.

D. melanogaster male and female flies were exposed to γ-radiation or fed on apholate for 24 h. Whole mounts of dissected ovaries and sectioned testes were examined to determine the effect of treatment.

1173 LaChance, L.E., Riemann, J. CYTOGENETIC INVESTIGATIONS ON THE NATURE OF DOMINANT LETHALS INDUCED IN MEIOTIC OOCYTES BY GAMMA RADIATION AND ALKYLATING AGENTS. (Abstr.) Genetics 48, 7 (1963) 896-7.

When adult females of the screwworm fly (Cochliomyia hominivorax) are treated with alkylating agents and ionizing radiation, dominant lethal mutations are induced in the oöcytes. Since the meiotic stage of the oöcytes is correlated with the age of the females, it is possible to treat oöcytes in early prophase, metaphase and anaphase of the first meiotic division. When such treatment is given, fewer dominant lethals are induced in the prophase oöcytes than in oöcytes in the other two stages. This trend was found in experiments with three alkylating agents and with γ-irradiation. Comparisons between two trifunctional alkylating agents (tretamine = TEM and thiotepa) with a bifunctional agent (2, 5-bis (1-asiridinyl)-3, 6-bis (2-methoxyehoxy)p-benzoquinone) reveal that the sensitivity pattern is the same regardless of the mutagen used, but that the mutagenic efficiency of the various agents differs considerably. The cytogenetic investigations permit comparisons of the nature of the chromosome aberrations associated with lethal events. Gamma irradiation of meiotic oöcytes with a lethal dose results in a high proportion of chromosomal aberrations during the 1st and 2nd meiotic divisions in the newly laid egg. In oöcytes treated with lethal doses of the alkylating agent there is a high percentage of normal appearing meiotic divisions. Dominant lethals induced in the sperm of treated males are expressed during the cleavage divisions following syngamy of the female and male pronuclei.

1174 Löbbecke, E.A., Borstel, R.C. von DIFFERENTIAL SENSITIVITY OF Habrobracon OOCYTES IN THE FIRST MEIOTIC PROPHASE AND METAPHASE TO CHEMICAL MUTAGENS. (Abstr.) Genetics 46, 8 (1961) 879.

See 1175

1175 Löbbecke, E.A., Borstel, R.C. von MUTATIONAL RESPONSE OF Habrobracon OOCYTES IN METAPHASE AND PROPHASE TO ETHYL METHANESULFONATE AND NITROGEN MUSTARD. Genetics 47, 7 (1962) 853-64.

Ethyl methanesulfonate (EMS) and nitrogen mustard [methyl bis(β-chloroethyl)amine hydrochloride] were used to induce dominant and recessive lethal mutations in the oöcytes. Oöcytes in the 1st meiotic metaphase were found to be much more sensitive to EMS and nitrogen mustard (~ 20 times) than oöcytes in 1st meiotic prophase when dominant lethality was the criterion. In this respect, the action of the chemical mutagens resembles that of x-radiation. With recessive lethality as criterion, metaphase I and prophase I oöcytes respond differently to x-radiation and chemical mutagens. A 2-fold difference prevails after x-irradiation, with metaphase I being the more sensitive stage. With nitrogen mustard, metaphase I is 3-5 times more sensitive than prophase I, and with EMS, no significant difference was found between metaphase I and prophase I. (From auth. summary).

1176 Löbbecke, E.A. MUTATIONAL RESPONSE OF Habrobracon OOCYTES IN METAPHASE AND PROPHASE TO ETHYL METHANE SULFONATE AND NITROGEN MUSTARD. (Abstr. BIF957) p. 73 in "Research and Development in Progress. Biology and Medicine. Issue No. 2", TID-4201. Division of Technical Information, USAEC. Nov. 1963.

See 1175.

1177 Oster, I.I., Carlson, E.A. COMPARATIVE MUTAGENESIS IN Drosophila USING X-RAYS AND ALKYLATING AGENTS. (Abstr.) p. 106 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

The dumpy locus (chromosome II-13.0) in D. melanogaster has several easily distinguishable pleiotropic effects and an internal pseudoallelic structure thus far shown to be composed of eight separable sites (Carlson and Southin, 1962). The mode of origin of mutations induced at this locus in mature spermatozoa by x-rays was found to differ markedly from that produced by a monofunctional alkylating agent of the quinacrine series of nitrogen mustards (2-methoxy-6 chloro-9(3-(ethyl-2-chloroethyl) aminopropylamino) acridine dihydrochloride). While the majority of such visible changes following x-irradiation seemed to occur as complete (i.e., whole-body) mutations, those produced by the quinacrine mustard were mainly transmitted mosaically (i.e., only to a part of the somatic and/or germinal tissues arising from any one single treated chromosome). The suggestion that a similar pattern should exist for recessive sex-linked lethal mutations was borne out by the finding that this agent produced fewer complete lethals (4%) (as detected in the conventional manner by examination of the F_2 generation) than mosaic lethals (13%) (as detected in the F_3 generation) in contrast to x-rays which Muller had already investigated in this connection in 1928. As with other chemicals, relatively few translocations could be detected by examination of the F_2 generation. Extension of the analysis to the F_3 generation did not increase this frequency appreciably although it did indicate that even such gross structural changes can occur as mosaics. Studies with a polyfunctional alkylating agent, triethylenemelamine (TEM), carried out as part of an extensive project in collaboration with C. Auerbach and L. Snyder yielded results essentially similar to those found for the monofunctional compound. Comparisons of the response of different gametogenic stages to x-rays and other chemical mutagens has also been studied. (From abstr.)

1178 Slizynska, H. MUTAGENIC EFFECTS OF X-RAYS AND FORMALDEHYDE FOOD IN SPERMATOGENESIS OF Drosophila melanogaster. Genet. Res. 4 (1963) 248-57.

The structural changes induced by x-ray in cells at different stages of spermatogenesis were analysed in salivary gland chromosomes of D. melanogaster and compared with the changes induced by formaldehyde added to the food (FF) of the larvae. The different stages of spermatogenesis vary in sensitivity to x-rays when measured by the percentage of sex-linked lethals, by the percentage of spermatozoa carrying structural changes, and by the number of changes per 100 spermatozoa. The proportions of the different types of change (T, In, Rp, Df), however, are fairly similar in all stages of spermatogenesis, but entirely different from those found after FF treatment. This suggests that it is the mutagen and not the sensitive stage which is responsible for the characteristic pattern of the FF effects. The differences between the effects of x-ray and of FF are attributed to the different proportions of potential breaks induced by these two mutagens. Evidence has been presented indicating that while most of FF induced breaks are potential (about 73%), most of the x-ray induced breaks are immediate. For the dose rate used in the present experiment (below 1000 r/min) only a small proportion (4-10%) of breaks induced by x-ray was found to be potential. (Auth)

1179 Sobels, F.H. RATES OF FORWARD AND REVERSE MUTATION IN Drosophila AFTER EXPOSURE TO MUSTARD GAS AND X-RAYS. Genetica 33, 1 (1962) 31-44.

After treatment with mustard gas, reversions of the mutant forked^{3n} were observed with a frequency of 1 in 7500. The study on reversion of f^{3n} was combined with tests for recessive visibles at 15 selected loci of the X-chromosome. Mutations at the ruby locus were most frequently induced by mustard gas (1 in

1700). About $\frac{1}{4}$ of the forward mutations were fractionals. After exposure to 5000 r x-irradiation both reversions of f3n and forward mutation at the loci under study were observed with frequencies comparable to those induced by mustard gas. Thus, no indication for mutagen-specific differences in mutational response have been obtained. After treatment with mustard gas a higher ratio of visibles to lethals was observed than after exposure to x-irradiation. Comparisons of the mutagenic effect of a chemical mutagen with that of x-radiation, even if restricted to visible mutations, inevitably involve an underestimate for the chemical, due to delayed effects of the latter. (From auth. summary)

1180 Weidhaas, D.E., Ford, H.R., Gahan, J.B., Smith, C.N. PRELIMINARY OBSERVATIONS ON CHEMOSTERILIZATION OF MOSQUITOES. Proc. N.J. Mosq. Ext. Ass. 48 (1961) 106-9.

Results obtained with radiosterilization are described. It appears that both sexes of Anopheles quadrimaculatus Say can be sterilized by exposing either pupae or adults to γ-radiation in doses of 8865-12 900 r. The presence of such sterile males reduced the total number of viable eggs laid by females caged with mixed populations of sterile and normal males. Field tests on the control of A. quadrimaculatus by the release of sterilized males were, however, unsuccessful. The studies described here were made to determine the effects of aphoxide (tris(1-aziridinyl)phosphine oxide), aphomide (N,N'-ethylenebis-(P,P-bis(1-aziridinyl)-N-methylphosphinic amide)) and apholate (2,2,4,4,6,6-hexa(1-aziridinyl)-2,4,6-triphospha-1,3,5-triazine) and amethopterin (N-(p-((2,4-diamino-6-pteridinylmethyl)methylamino) benzoyl)glutamic acid) on the fertility of A. quadrimaculatus and Aëdes aegypti (L.). Aphoxide, aphomide and amethopterin were used at concentrations of 0.1-1% against both species, and apholate at the same concentrations against Anopheles and at 0.01-5% against Aëdes. Mosquitos of both sexes were given continuous access to the compounds in a mixture of honey and water, and a blood-meal was given 4d after peak emergence and again after oviposition.

No females of either species oviposited after they had received 1% aphoxide, and none that received 0.5% laid viable eggs. Those that received 0.1% laid the normal number of eggs but hatching was reduced, particularly among eggs laid after the second blood-meal. Aphomide was similar to aphoxide in its effect on egg production in A. quadrimaculatus but less effective than either apholate or aphoxide with Aëdes. It reduced the number of eggs laid at 1% and the hatch at all concentrations, but it allowed a few eggs to hatch, even at 1% Amethopterin had little effect on either species, except for a partial reduction in the hatching of eggs of A. aegypti at 1%.

See also:

842 A study of gene and chromosome changes induced by ionizing radiations in Drosophila melanogaster. (Edington, 1963)
957 The preliminary investigation of salivary gland chromosomes of Chironomus tentans Fabr. from the Clinch river. (Nelson and Blaylock, 1963)
971 Unequal crossing-over in the bar region of Drosophila melanogaster; influence of temperature, x-rays and EDTA. (Rasmuson, 1961)
974 Origin of repeats in Drosophila chromosomes. (Slizynska, 1963)
1330 The influence of X-rays on longevity, fecundity and fertility of Drosophila melanogaster. (Nöthel, 1963)
1378 Mating ability of male mosquitoes, Aedes aegypti (L.), sterilized chemically or by gamma radiation. (Weidhaas and Schmidt, 1963).

I-A-8 BIOCHEMISTRY. PHYSIOLOGY. ULTRASTRUCTURE. PATHOGEN SUSCEPTIBILITY

1181* Aruga, H. MECHANISM OF RESISTANCE TO VIRUS DISEASES IN THE SILKWORM Bombyx mori (IV) (V) (VI). J. seric. Sci., Tokyo 27 (1958) 5-9.

It did not prove possible to produce nuclear or cytoplasmic polyhedra by submitting B. mori larvae to x-rays or ultraviolet radiation.

1182 Aruga, H., Yoshitake, N. STUDIES ON THE INDUCTION OF NUCLEAR AND CYTOPLASMIC POLYHEDROSES BY TREATING WITH X-RAYS AND ULTRAVIOLET LIGHT IN THE SILKWORM, Bombyx mori L. Jap. J. appl. Ent. Zool. 5, 1 (1961) 49-56. (In Japanese, with English summary).

No further induction was observed following exposure to ultraviolet light and x-rays respectively. It was only on dual treatment (exposure to x-rays and low temperatures, i.e. 5°C for 24 h) that test larvae showed a higher percentage of deaths from virus than controls. The percentage of larvae with both nuclear and cytoplasmic evidence of disease was markedly higher when larvae had been treated with x-rays pre- or post-cold treatment than when larvae had been exposed to low temperature only in the 5th instar larval stage, soon after ecdysis. (From summary)

1183 Aruga, H. 15. INDUCTION OF VIRUS INFECTIONS. 2. ULTRAVIOLET LIGHT AND X RAYS. p. 507-8 in "Insect Pathology. An Advanced Treatise. Vol. I". Steinhaus, E.A., Ed. New York, Academic Press. 1963.

There was no indication that exposure to x-rays increased the percentage of polyhedrosis-infected larvae of silkworms, but in the case of treatments both with x-rays and low temperature (5°C 24 h), more virus-caused deaths resulted in the test larvae than in the control. The percentage of larvae with nuclear and cytoplasmic polyhedroses was markedly higher in those larvae treated with x-rays before and after cold treatments than in those treated only with low temperature in the 5th instar larval stage, soon after ecdysis.

1184 Baccetti, B., De Dominicis, R., Cappellini, M. MODIFICAZIONI ISTOCHIMICHE ED ULTRASTRUTTURALI INDOTTE DALLE RADIAZIONI IONIZZANTI SUL MESENTERO DI Dacus oleae Gmel. (Histochemical and ultrastructural modifications in the mesenteron of Dacus oleae Gmel. induced by ionizing radiations). Redia 46 (1961) 205-22. (In Italian, with English summary).

Pupae were irradiated with 12 000 to 50 000 r of x-rays, the lowest dose able to produce electronmicroscopically detectable changes being 30 000 r. Higher doses caused injury which differed according to the 3 types of cells found in the mesenteron. Morphologically, such damage consisted of the displacement or disappearance of microvilli, and heavy macroscopic secretion; fragmentation of the nucleoli; and the appearance of vacuoles in the ergastoplasm and Golgi apparatus. From the enzyme point of view, observations indicated the disappearance of succinic-dehydrogenase and cytochromoxidase at the stage of maximum cellular damage. (Work on this topic was published earlier in Redia 45 (1960) 113-31)

1185 Baccetti, B., De Dominicis, R. THE EFFECTS OF GAMMA RADIATION ON THE OVARIES OF Dacus Oleae Gmel. p. 387-411 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

The ovaries of unfertilized adult females of the olive fly, Dacus oleae, irradiated in the middle period of the pupal stage with various doses (2-30 kr) of γ-rays were studied by cytological and ultramicroscopic techniques. In all cases the treatment inhibits the normal development of the ovary. Nurse cells and egg cells are very small and few in number and show abnormal structure and ultrastructure, particularly as regards the cytoplasmic organelles.

1186 Baumiller, R.C. VIRUS-HOST RELATIONSHIP AND THE EFFECTS OF X-RAY INDUCED MUTANTS IN HETEROZYGOUS CONDITION. (Abstr. 5.54) p. 73 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

The only reported phenotypic effect of the "virus" sigma has been to make its Drosophila host sensitive to CO_2. L'Heritier has reported strains of virus-carrying flies which differ according to the stability of the virus-host relationship. The experiments, presently communicated, examined the effects during developmental stages of x-ray induced mutants in heterozygous condition on several of these strains. Sensitive (S) and sibling cured (R) virgin females were collected from the strain to be tested and mated to sibling cured males who had (X) or had not (U) received 3000 r of x-rays. In a cured line the presence of the virus can no longer be demonstrated. After a 2-d mating period the females were placed in net-enclosed cylinders and eggs were collected over ½h-periods. Each hour, beginning with the 21st hour after oviposition, the number of larvae hatching were scored. The effect of mutants in heterozygous condition on time of egg hatching varied according to the stability of the virus in the strain tested. (From abstr.)

1187 Grosch, D.S. CYTOLOGICAL INTERPRETATIONS OF FIVE TYPES OF INDUCED MODIFICATION IN THE OVIPOSITION-PATTERN OF THE WASP Habrobracon. (Abstr. 5.53) p. 73 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

In contrast to Diptera where ovaries may not mature for several days, at eclosion, differentiated and transitional cells are present in the sequential series provided by the polytrophic ovariole of the parasitoid wasp Habrobracon. Furthermore, ovarioles invariably number only four, and quantitative modifications of the pattern of egg deposit may be traced back to the cellular state of their contents. When eggs are plotted against days, control females quickly reach a sloping plateau maintained for about 15 d until the sharp senile decline occurs. Low and moderate radiation exposures result in (1) a 2-humped curve. The interposed valley, which can dip to temporary infecundity, attests to the vulnerability of transitional cells which undergo 5 successive mitotic divisions. High doses of radiation destroy the oögonia as well as transitional cells. This results in (2) a rapid decline to permanent infecundity within the 1st week. Single-meal ingestion of metal cations and classic organic enzyme inhibitors produce a constant deficit throughout life, reflected as (3) a curve lower and parallel to that of controls. A general debility of somatic tissues ensues rather than a direct effect upon the gonads. Ingested antimetabolites can also give type 3 curves, but more typical is (4) an initial lag phase of up to 5 d resulting from oöcyte retardation and degeneration attendant interference with nurse cell function. Nuclear disturbance is involved and may be obtained with agents influencing either protein or nucleic acid synthesis. Aureomycin, methotrexate, DON, or FUDR give similar type 4 curves when used in proper concentration. Antimitotic agents provide still another type of curve (5) characterized by a compensatory deposit of temporarily arrested cells which make up for earlier deficits.

1188* Karpov, A.E. ON POLYHEDRAL DISEASE IN THE SILKWORM INDUCED BY X-RAYS. Dopov. Akad. Nauk Ukr. SSR 9 (1959) 1015-18. (In Ukrainian).

Eggs and caterpillars of various instars of the silkworm (breed US-1) were irradiated with soft x-rays ($\lambda = 1.2$ A), using doses from 1000 to 80 000 r in order to study polyhedrosis morbidity. Irradiation of eggs with doses over 10 000 r resulted in the death of practically all the embryos but no polyhedrosis was detected. Irradiation of caterpillars with doses from 10 000 to 80 000 r also caused a very high mortality (62 to 97%) due to physiological weakness and to a lesser extent to bacterial diseases. Irradiation with doses from 1000 to 6000 r did not perceptibly affect the development of the caterpillars, but resulted in a significant increase in the frequency of polyhedral disease as compared with the controls. This increase was especially marked when the caterpillars were irradiated with doses of 5000 to 6000 r (33.5 ± 3.2% polyhedrosis-diseased individuals as compared with 8.4 ± 1.8% in the controls). As shown by infection tests, the susceptibility of caterpillars to polyhedrosis did not increase after irradiation. This leads to the conclusion that irradiation causes an activation of latent virus in the silkworm. (Auth.) (NSA 14: 1960, 1681)

1189 Kaufmann, B.P., Gay, H. CYTOLOGICAL EVALUATION OF DIFFERENTIAL RADIOSENSITIVITY IN SPERMATOGENOUS CELLS OF Drosophila. p. 375-408 in "Repair from Genetic Radiation Damage". Sobels, F.H., Ed. Oxford, Pergamon Press. 1963.

The radiosensitivity of spermatogenous cells of Drosophila as studied by cytologists and cytogeneticists is reviewed. Radioautographic chronometry, structural changes predisposing to differential radiosensitivity, and the effects of radiations on DNA and on the nucleoprotein complex that constitutes the chromosome are discussed. 93 references are included. (NSA 18: 1964, 11841)

1190 Kenworthy, W. RADIATION EFFECTS ON THE CYTOPLASM OF Habrobracon EGGS. Final report, June 1, 1965 - May 31, 1962. TID-16471, Brown Univ., Providence. 31 May 1962. 22p.

The cytological events involved in androgenesis and the rate of production of androgenic males were studied extensively. Eggs which had received sufficiently high x-ray doses for inhibition of functioning of the female pronucleus were examined cytologically. Dose-action survival curves (4200 r - 70 000 r) were plotted for fertilized eggs which had received x-irradiation prior to fertilization. No survivors were found at 42 000 r. The curves were a measure of the production of androgenic males. Neutrons of 14.13 MeV (6.0×10^9 n/cm^2 - 3.14×10^{11} n/cm^2) showed that the more densely ionizing radiations induced higher levels of lethality in eggs irradiated during meiotic metaphase I than in eggs irradiated during meiotic prophase I. Effects of x-rays on cleavage mechanism were studied. In order to allow a study of nuclear and cytoplasmic injury induced by low x-ray doses, attempts were made to produce androgenic males by heat shock and anoxia, applied when the female pronucleus was going through critical stages in its meiotic development. These were abandoned. Attempts were also made to produce such males from hybrid crosses of 2 different species of Habrobracon.

1191 McGrath, R.A. X-RAY INDUCED INCORPORATION OF TRITIATED THYMIDINE INTO GRASSHOPPER NEUROBLAST CHROMOSOMES. Diss. Abstr. 23, 9 (1963) 3562.

For abstract, see 1192. Results are interpreted as a reflection of repair of x-ray-damaged DNA. A correlation is suggested between detectable chromosome breakage, the normal DNA synthesis period, and labelling of delayed, stopped or reverted prophase neuroblasts.

1192 McGrath, R.A. X-RAY-INDUCED INCORPORATION OF TRITIATED THYMIDINE INTO DEOXYRIBONUCLEIC ACID OF GRASSHOPPER NEUROBLAST CHROMOSOMES. Rad. Res. 19 (1963) 526-37.

Direct observation of irradiated Chortophaga neuroblasts at identifiable stages of the cell cycle in the living condition, shows that changes in chromosome morphology which are characteristic of mitotic stoppage or delay can be detected within 15 min after 32 r of x-rays. Four more or less distinct mitotic responses of irradiated prophase neuroblasts can be distinguished, and are discussed, also for a dose of 250 r. Living neuroblasts exposed to tritiated thymidine (H^3T) and then irradiated in hanging-drop preparations and reidentification of the same cells in autoradiograms of sectioned material show that prophase neuroblasts which are delayed, stopped, or reverted mitotically in response to 32 r of x-rays incorporate H^3T. Incorporation is greater in cells irradiated in early prophase. No incorporation is observed in cells treated in very late prophase. Labelling can be detected within 15 min after x-irradiation of early or middle prophase neuroblasts. Incorporation is not seen in preparations treated with DNase before application of autoradiographic emulsion. After 250 r of x-rays, prophase cells which do not divide within about 40 min do incorporate H^3T during reversion to an interphase-like condition.

1193 Nakanishi, Y.H., Mizutani, M., Makino, S. QUANTITATIVE MEASUREMENTS ON CHROMOSOME MOVEMENT IN GRASSHOPPER SPERMATOCYTES WHICH HAD RECEIVED BETA-IRRADIATION. (Abstr.) Jap. J. Genet. 36 (1961) 389. (In Japanese).

1194 Nicklas, R.B. A QUANTITATIVE STUDY OF CHROMOSOMAL ELASTICITY AND ITS INFLUENCE ON CHROMOSOME MOVEMENT. Chromosoma 14 (1963) 276-95.

Melanoplus differentialis (Locustinae) (from a laboratory population) and Chortophaga viridifasciata (Oedipodinae) (from a wild population) were employed; $1\frac{1}{2}$-5 d before use, the Melanoplus males were given 500 r x-rays in 3-4 min. Observations of live cells were made by phase microscopy. Chromosome elasticity and movement were studied in two distinct situations: early anaphase stretch due to opposed external forces (Chortophaga), and drag stretch, an elongation due to frictional resistance or drag on a chromosome being pulled towards one pole. Thus, if the Melanoplus X-chromosome is partly broken by x-irradiation and its behaviour during 1st spermatocyte division examined, stretching in the region of the break is seen when the chromosome moves. Neither stretch produces detectable alterations in the velocity of chromosome movement. A simple mechanical model is described which allows the ratio between frictional and elastic coefficients to be calculated. It is concluded that the mitotic forces are continually adjusted to produce a standard velocity of movement even when an unusual hindrance exists. The implications are considered particularly concerning stretching and rupture of dikinetochoric ("dicentric") bridges in anaphase.

1195* Mathur, R.S. STUDIES ON THE NORMAL AND X-IRRADIATED SPERMATOGENESIS OF Stenobothrus viridulus and Schistocerca gregaria (ORTHOPTERA). Cellule 61, 2 (1960) 173-90. (In English).

Normal spermatogenesis is described. The effects of x-irradiation (200 r for 5 min 30 sec on the common grasshopper, S. viridulus, and 300 r for 6 min 40 sec on the locust, Schistocerca) caused the mitochondria and Golgi bodies to fuse in spermatocytes. In Schistocerca, the Golgi bodies form an abortive acroblast in a delayed spermatocyte. In both cases the Golgi bodies are displaced from their normal position. The Golgi-idiosome complex can be distinguished in the spermatocytes. The centriole region divides in both species to form 4 bodies. In Stenobothrus, a small flagellum develops from each body.

1196 Mathur, R.S. THE EFFECT OF X-RADIATION ON THE SPERMATOGENESIS OF Petrobius maritimus. Proc. roy. Irish Acad., B 61, 16 (1961) 275-81.

Specimens were subjected to 300 r or 500 r of x-rays, at 50 r/min. These doses proved lethal for spermatogonia. The first visible changes in the spermatocytes and spermatids appeared within 24 h. The nuclei became greatly enlarged and lost their staining power. A lateral thickening was observed along the wall of the elongating spermatid nucleus (the adnuclear fold was also present in normal cells but its development is more easily followed on irradiation). The Golgi body lost its original shape and became very much enlarged, with a lamellar outline and condensation of the granules at the centre. The centriole regions divided into the proximal and distal centrioles. The flagellum seemed to arise from the proximal centriole and to pass through the distal centriole. The flagellum grew out of the cell from an early stage, whereas at no stage in the normal spermatid is the flagellum extra-cellular. Mitochondria were found to lag behind in the formation of the primitive nebenkern in the earlier stages of development.

1197 Mathur, R.S. CYTOCHEMISTRY OF THE NORMAL AND X-IRRADIATED SPERMATOGENESIS OF Stenobothrus viridulus (Fischer). Cytologia, Tokyo 28, 2 (1963) 113-7.

Stenobothrus (5th instar) were collected and reared to adulthood. An optimum dose of 200 r x-rays (100 kV, 17.5 mA, at 50 cm, with 0.5 mm Al filter) was given, and testes were fixed at 72-h-intervals. The first visible changes occurred after 7 d. In the irradiated nucleus, the site of DNA and basic proteins were clearly marked. The DNA aggregated along the nuclear membrane, the proteins concentrated in the centre. The mitochondria and the mitochondrial nebenkern of the normal material consist of tyrosine and arginine, the outer membrane of the nebenkern containing acidic lipids and cholesterol. In irradiated material, the intensity of the reactions increased with the coagulation of the proteins. Various protein groups coagulated in irradiated spermatocytes. This persisted in the spermatids where the core consisted of protein masses while the membrane maintained its lipoidal nature without showing any irradiation effects. With regard to Golgi bodies which consist of galactogen, acid mucopolysaccharides (sulphuric acid groups only) and acidic lipids, the polysaccharides were observed to lose their staining power on irradiation while the lipids formed the outer membrane. In the acrosome, which is PAS positive and also contains tyrosine, the tyrosine content became more pronounced. The centriole region consists of lipids and proteins. Coagulation of the proteins allowed them to be clearly differentiated from the lipids.

1198 Oishi, H. SOME PHASE OPTIC OBSERVATIONS ON THE FORMATION OF A CLEAVAGE FURROW IN BETA-IRRADIATED GRASSHOPPER GERM CELLS. J. Fac. Sci. Hokkaido Univ., Ser. VI. Zool. 15, 1 (1962) 37-42.

Podisma sapporense was used in the study.

1199 Струнников, В.А. ОТНОСИТЕЛЬНАЯ ЧУВСТВИТЕЛЬНОСТЬ К РАДИОИЗЛУЧЕНИЯМ ЯДРА И ЦИТОПЛАЗМЫ ПОЛОВЫХ КЛЕТОК ТУТОВОГО ШЕЛКОПРЯДА. Стр. 109-15 в сб. "Труды Ташкентской конференции по мирному использованию атомной энергии", т.3, Ташкент. 1961.

Strunnikov, V.A. COMPARATIVE RADIOSENSITIVITY OF THE NUCLEUS AND CYTOPLASM OF THE SEXUAL CELLS OF THE MULBERRY SILKWORM. p. 109-15 in "Proceedings of the Tashkent Conference on the Peaceful Uses of Atomic Energy", Vol. 3, Tashkent, 1961.

1200 Tahmisian, T.N., Devine, R.L. THE INFLUENCE OF X-RAYS ON ORGANELLE INDUCTION AND DIFFERENTIATION IN GRASSHOPPER SPERMATOGENESIS. J. biophys. biochem. Cytol. 9, 1 (1961) 29-45.

The effect of x-irradiation on grasshopper* spermatogenesis was studied with the aid of light and electron microscopy. The insects were irradiated at the 2nd instar prior to the presence of maturation stages and observed at the last instar and imago stages. Dosages of 100 to 600 r were found to retard the differentiation of the nucleus and mitochondrial nebenkern in spermatids. Evidence is presented that irradiation causes a curtailment and disorganization in the differentiation of the nebenkern from mitochondria. The above doses also induced the formation of supernumerary centrioles, flagellar filaments and acrosomes; nuclear disorganization as well as pycnosis and fragmentation also occur. The nucleus appears to be drawn toward each radiation-induced supernumerary acrosome, with consequent multipolarity of the nucleus. Induction of a set of flagellar filaments is seen only where the centriolar structure is in contact with the nucleus. Details are given of an organelle, not described heretofore, that is composed of anastomosed and interwoven cytoplasmic strands. (Auth.)

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* Melanoplus differentialis differentialis Thomas.

1201 Tahmisian, T.N. CYTOLOGICAL EFFECTS. p. 333-52 in "Mechanisms in Radiobiology. Vol. I. General Principles". Errera, M., Forssberg, A., Eds. New York, Academic Press. 1961.

Review article, concentrating on data obtained with grasshopper embryos. The effects of radiation on the nucleus are discussed. Thus, in the resting nucleus subsequent differentiation and not mitosis are stopped. The radiosensitivity of the dividing cell is related to the degree of intracellular differentiation associated with the division process. Radiation causes partial or complete degradation of the mitotic spindle. As for meiosis, the metamorphosis of spermatid to spermatozoon appears to be more sensitive than the meiotic divisions. Radiation effects on the cytoplasm were studied by the author on *Melanoplus differentialis differentialis* Thomas, particularly by electron microscopy. The effects on centrioles, filaments (spindle, tail structures), mitochondria, Golgi bodies and acrosomes, and on undifferentiated cytoplasm are described.

1202 Tahmisian, T.N. AN ELECTRON MICROSCOPE STUDY OF IRRADIATION DAMAGE PRIOR TO MYOGENESIS. (Abstr.) p.226 in "2nd International Congress of Radiation Research, Harrogate, Yorkshire, England. 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Using grasshopper embryos (*Melanoplus differentialis*) it was found, with the aid of the electron microscope, that 50 to 100 r on the 1st day of post-diapause development will abolish myogenesis, which occurs on the 8th day of post-diapause development. Prior to or after the 1st day of post-diapause development, 250 r is ineffective in arresting myogenesis. Sarcoblast nuclei normally contribute to the formation of the Z bands as well as to the myofibrillar filaments. It is possible that the origin of the damage to the inductive process of myogenesis is associated with nuclear DNA because the chromatin as well as the nucleus undergoes karyoklasis during muscle formation. The most sensitive generalized biological reaction to x-irradiation appears to involve some "trigger" system that precedes molecular redistribution during morphogenesis. (From abstr.)

1203 Vago, C. *11.* PREDISPOSITIONS AND INTERRELATIONS IN INSECT DISEASES. 3. IRRADIATION INJURY. p.351 in "Insect Pathology. An Advanced Treatise. Vol.I", Steinhaus, E.A., Ed. New York, Academic Press. 1963.

The effects of various radiations, including x-rays, on the course of certain diseases, e.g. nuclear polyhedrosis in *Bombyx mori*, is discussed.

See also:

863 Cytological effects of x-rays in relation to dose-rate in *Drosophila melanogaster*. (Gunson, 1962)
928 Cytogenetic studies following high dosage paternal irradiation in the mealy bug, *Planococcus citri* (Risso). (Chandra, 1962).
929 Cytogenetic studies following high dosage paternal irradiation in the mealy bug, *Planococcus citri*. I. Cytology of X_1 embryos. (Chandra, 1963)
930 Cytogenetic studies following high dosage paternal irradiation in the mealy bug, *Planococcus citri*. II. Cytology of X_1 females and the problem of lecanoid sex determination. (Chandra, 1963)
942 Arrangement of chromosomes in mature sperm. (1) (Herskowitz and Norton, 1963)
943 Arrangement of chromosomes in mature sperm. (2) (Herskowitz *et al.*, 1963)
956 Phase cinematography studies on the effects of radiation and chemicals on the cell and the chromosomes. II. Formation of anuclear buds, continuation of chromosome stickiness and formation of an accessory nucleus in grasshopper spermatocytes following x-irradiation. (Nakanishi and Makino, 1960)
965 Cytological demonstrations of induced breakage in somatic chromosomes of *Drosophila*. (Oster and Balaban, 1962)
989 The immediate cytological effects of ionizing radiations. (Carlson, 1958)
999 Studies of early effects of radiation on chromosomes and mitosis. (Carlson, 1963)
1009 Methods for estimating differential radiosensitivity. (Oster and Pooley, 1963)
1013 A cytogenetic study of the effects of x irradiation on *Aedes aegypti*. (Rai, 1963)
1100 Modification of genetic damage produced by ionizing radiation. (Oster, 1963)
1219 Comparative studies of cytochrome c oxidase activity and mutability in two strains of *Drosophila*. (Ward and Bird, 1962)
1220 Cytochrome oxidase activity in chromosome interchange stocks of the Oslo and iso-Amherst strains of *Drosophila melanogaster*. (Ward and Bird, 1963)
1264 Radiosensitivity of developing reproductive cells in female *Cochliomyia hominivorax*. (LaChance and Leverich, 1962)
1299 Effects of x-irradiation upon cell population and morphogenesis in the developing beetle wing. (Beck and Hayes, 1962)
1300 Cell differentiation and radiopathology in the wing of *Tribolium confusum*. (Beck, 1962)
1301 Effects of x-irradiation upon cell population and morphogenesis in the wing of *Tribolium confusum*. (Beck, 1962)

I-A-9 TUMOUR INDUCTION

1204 Brown, E.H., King, R.C. THE OCCURRENCE OF OVARIAN TUMORS IN *Drosophila melanogaster* HETEROZYGOUS FOR AN UNSTABLE CHROMOSOME. (Abstr.) *Genetics 46*, 8 (1961) 854.

During normal oögenesis about one developing egg chamber in 20 000 becomes tumorous. Irradiation of newly emerged females with 4000 r of Co^{60} γ-rays increases the frequency of tumour about 26 times. Ionizing radiation is known to result in chromosome breakage and subsequent loss of the acentric fragments. This fact suggests that deletion of segments and chromosomal elimination may lead to the production of tumours. To check this point a study was made of the reproductive systems of individuals heterozygous for an unstable, ring X chromosome. A total of 3893 egg chambers from 53 ovaries (representing 31 gynandromorphs) were examined, and 125 (3.21%) of the chambers were found to be tumorous. These tumours were distributed among 11 of the gynandromorphs examined. The gynandromorphs were obtained by crossing $In(1)X^{c2}$, w^{vc}/yw^{m4} females to yw^{m4} males. Cytological study of the tumours indicates that at least some arise through the invasion of the egg chamber by cells arising from the follicular envelope, as tongues of these cells are often observed which extend from the follicular epithelium into the chamber. In cases where the chamber is filled with small tumour cells (and no nurse cells or oöcyte are present) the tumour may be of germ cell origin. A study of the karyotype of the tumour cells is under way.

1205 Burnet, B. THE ACTION OF TUMORIGENIC TREATMENTS AND PROTECTIVE AGENTS ON MELANOTIC TUMOUR FORMATION IN *D. melanogaster*. (Abstr.) *Heredity 18*, 4 (1963) 554.

The tu bw: st su-tu strain of *Drosophila melanogaster* carries a melanotic tumour gene on the second chromosome and a specific tumour suppressor on chromosome three. Plaine and Glass (Science 126: 1957, 683) showed that penetrance of this tumour is greatly increased by x-ray treatments or by an excess of l-tryptophan in the diet, and that the effect of these treatments can be counteracted by l-cysteine. They suggest that both tumorigenic treatments act upon the tryptophan peroxidase-oxidase mediated reaction, the product of which, formylkynurenine, interferes with the action of the suppressor gene. Current investigations using chemically defined germ-free media do not support these propositions since tryptophan and x-ray treatments operate through temporally distinct developmental events, and studies on the protective effect of l-cysteine, l-methionine and cystamine point rather to a genetically controlled defect of sulphur metabolism.

1206 Ghélélovitch, S. INFLUENCE OF X RAYS ON THE DEVELOPMENT OF MELANOTIC TUMORS IN *Drosophila* (*Drosophila melanogaster*). *Bull. Ass. franc. Cancer 48* (1961) 151-73.

Irradiation of the embryos or larvae considerably increases the incidence of melanotic tumours in these flies. Irradiation of germinal cells does not influence development of tumours in flies developing from the cells. The presence of the tumour gene in the genotype of the egg or larva is an essential condition for the tumorigenic action of irradiation. The statistical distribution of tumours in irradiated populations conforms to Poisson's law, and it is independent of the stage of ontogenesis at the time of irradiation. The effects of several irradiation treatments are additive, and the incidence of tumours increases with the dose to an upper limit of 600 to 800 r. Beyond 1200 to 1500 r the incidence of tumours decreases as mortality increases. Between doses of 0 and 600 r the incidence of tumours rises linearly from 10% to 95%, respectively. In contrast, the slope of the curve of induction of tumours depends neither on the incidence nor on the level of tumour gene; it seems to be influenced by cytoplasmic and maternal factors. When irradiation increases the number of tumours, it simultaneously increases their size and rapidity of their appearance. Irradiation does not modify the histologic appearance of the tumours. Occasionally tumours were observed in the leucopoietic tissue of the larva. The phagocytic activity of blood cells was not affected by irradiation. The increased incidence of tumours in irradiated *Drosophila* cannot be attributed to selective mortality or to inhibition of defense factors against tumour cells. The failure of irradiation to have a tumorigenic effect in older larvae indicates that it does not affect the development and growth of tumours once formed. It is suggested that irradiation increases the sensitivity of larval cells to a tumour-inducing agent controlled by the tumour gene. (NSA 16: 1962, 1273).

1207 Sang, J.H. EFFECTS OF ENVIRONMENTAL MANIPULATION ON THE PENETRANCE OF MELANOTIC TUMOURS IN SUPPRESSED AND UNSUPPRESSED STRAINS OF *D. melanogaster*. (Abstr.) *Heredity 18*, 4 (1963) 554-5.

If x-rays and excess tryptophan both increase tumour penetrance in the tu bw: st su-tu strain by inhibiting the action of the suppressor gene, it should follow that strains not carrying the suppressor would have a different reaction to environmental treatments. Tests with germ-free, synthetic diets containing excesses or deficiencies of individual nutrients show that the majority of treatments affect tumour penetrance in the same way, whether or not the su-tu gene is present. This suggests that these treatments influence the expression of the tumour gene directly, rather than through the suppressor. Since many metabolically unrelated treatments are similarly effective, it also seems unlikely that they operate directly through a specific metabolic pathway. The general implications of these results for tumorigenesis will be considered.

See also:

840 The "Brown spot" character in Drosophila melanogaster and their response to x rays. (Di Pasquale, 1960)

I-A-10 SPECIES. STRAINS. LINES (COMPARATIVE STUDIES)

1208 Centeno, A.J., Reguly, M.L., Cordeiro, A.R. CHANGES OF REPRODUCTIVE PERFORMANCE OF Drosophila willistoni AT TWO INBREEDING LEVELS. (Abstr. 5.61) p. 75-6 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

From 608 wild inseminated females 123 outbred strains with inbreeding of 0.26 and 124 sibmating strains with f=0.65 (at 6th generation) were obtained. At the 5th generation each strain was divided in two strains each with 15 pairs of flies. For each strain one culture was submitted to 600 r of a Co^{60} γ-source. The relatively outbred strains gave a total of 40 126 flies in the control (K) and 41 363 from the irradiated parallel cultures (R). An hierarchal analysis of variance showed no significant difference between treatments (F = 0.002, F.05 (1244) = 3.89). The same non-significant result was obtained at the more inbred strains in a total of 28 158 flies in the control and 27 100 F_1 of irradiated strains.
A paired analysis of irradiated-control failed to show any significant overall increase of the irradiated or the control. Considering all the paired strains in which a betterment of reproductive performance was observed after radiation, a parcel of 51.22% among 123 strains and 45.16% among 124 strains, contributed to a significant t value. We have indications that several strains do increase performance after radiation. The average effect on the total population is certainly counterbalanced by the others that shows a significant decrease.

1209 Jucci, C. SULL'EVOLUZIONE DEL PARASSITISMO SOCIALE NELLE FORMICHE. TENTATIVI DI INTERPRETAZIONE GENETICA E PROGETTI DI ANALISI SPERMENTALE. (Study on the evolution of social parasitism in the ant. Attempts of genetic interpretation and plans for experimental analysis). p. 389-420 in "Symposia Genetica et Biologica Italica. Atti del IV Congresso dell'U.I.E.I.S., Pavia, 9-14 Settembre 1961. Vol. XII". Pavia, Tipografia del Libro S.A.S. 1963. (In Italian).

A critical review and assessment of the problems presented by social parasitism in ants is presented. The chances of using (radiation-)induced mutations for investigating the evolutionary and species aspects of differentiation are discussed (p. 407-).

1210 Kidwell, J.F. GENOTYPE X ENVIRONMENT INTERACTION WITH ISOGENIC LINES OF Drosophila melanogaster. Genetics 48 (1963) 1593-1604.

Two experiments which exploit some of the peculiar genetic properties of D. melanogaster were conducted to study the nature of the interaction of genotype X environment. All possible crosses were made among 4 isogenic lines, each representing a different mass mated stock. A sample of virgin females from each line, line cross, and original mass mated stock was irradiated (6000 r or 4000 r) at about 48 h of age. A similar non-irradiated sample was also measured. The traits measured were number of eggs and live larvae produced by days 4, 6, and 8, and the number of adults eclosing from eggs deposited on days 9, 10 and 11. The analysis provides a comparison of three breeding types, and estimates of inbreeding depression, heterosis, general and specific combining ability, maternal and reciprocal effects and their interaction with treatment. Significant effects were observed for treatments, breeding types, mass mated stocks and isogenic lines in both experiments. Differences in general combining ability were found for egg and larva number but not for number of adults in both experiments. Large interactions of treatment X breeding type, treatment X mass mated stock, and treatment X isogenic line were observed for all traits at 6000 r, whereas at 4 000 r only 2 of these interactions were significant. (NSA 18: 1963, 5046).

1211 Kitzmiller, J.B., Keppler, W.J. SALIVARY GLAND CHROMOSOME MAPS IN Culex p. pipiens. (Abstr.) Genetics 46, 8 (1961) 875-6.

Salivary gland chromosome maps have been prepared for the mosquito Culex p. pipiens. The strain used was originally collected in the field in Champaign, Illinois. The salivary chromosome complement consists of three pairs of synapsed, polytene, banded chromosomes. Each pair is usually closely synapsed but asynaptic regions have been observed in all 3 pairs. The bands vary in intensity of staining and occur in definite patterns. All chromosome ends can be recognized by shape and banding patterns. Each pair consists of an indistinctly banded central portion, probably the centromere region, and two arms of approximately equal length. Average measurements in microns for each chromosome are: I, left arm, 150; centromere, 20; right arm, 165; II, left arm, 170; centromere, 20; right arm, 225; III, left arm, 200; centromere, 30; right arm, 225. The shorter arm has in each case been arbitrarily called the left arm. Following the Drosophila convention, each chromosome has been divided into numbered regions, with subdivisions of each region designated by letters. Chromosome I contains regions 1-22; chromosome II, 23-50; and chromosome III, 51-80. Each arm contains several prominent banding sequences which provide distinct identification. Each chromosome contains a central, "double bulb", with indistinct bands. This region has tentatively been identified as the centromere region, and good preparations show bands suggestive of a reversed repeat pattern. Meiotic chromosomes (testis, metaphase I) measure 6.2, 7.7 and 8.5 microns, with median centromeres and arms of approximately equal length. There are no recognizable heterochromosomes. The salivary maps herein reported have been designated as "standard" maps and are being used for comparison of the patterns in Culex p. fatigans and in several x-ray mutants.

1212 Ooi, H. DIFFERENCE OF RADIATION SENSITIVITY BETWEEN INBRED LINES AND THEIR HYBRIDS IN THE SILKWORM. (Abstr.) Jap. J. Genet. 37 (1962) 408. (In Japanese).

1213 Shapiro, N.I., Strashnenko, S.I., Plotnikova, Ye.D., Suslikov, V.I. A COMPARATIVE ASSESSMENT OF THE INJURIOUS EFFECT OF IONIZING RADIATION ON HEREDITY IN MOUSE AND Drosophila. (Abstr.) Soviet Bloc Mainland China Tech. J., Ser. VI Bio-Sci. 61-11 145, 26 (1963) n.p. English abstract.

The rate of the formation of dominant lethals was used as an indicator of the effect of radiation. Gonads in 2 ½-4 month-old male mice were irradiated with x-rays at 134, 268, 402 and 670 r, followed by mating with 2 females for 3 d. On the 14-16th day of pregnancy these were opened and the number of yellow bodies, implantation sites and embryos assessed. Embryos killed both before and after implantation were determined, due to dominant lethals in the spermatozoids or the irradiated males. Similar data for maximum and minimum radiosensitivity in different lines of D. melanogaster were used from previous studies. Comparison of the rates of formation of dominant lethals in mice and D. melanogaster indicated that mice are 5-9 more radiosensitive than D. melanogaster. (Auth.)

1214 Sokoloff, A. PRELIMINARY STUDIES ON THE EFFECT OF X-RAY ON Tribolium IMAGOES. (Abstr.) Genetics 46, 8 (1961) 899.

3-d-old imagoes of T. castaneum and T. confusum were exposed to x-ray dosages of 1500, 3000 and 6000 r administered in 2.5, 5 and 10 min, respectively. The various studies lead to the following conclusions: (1) Productivity (measured in terms of F_1 adults produced) of T. castaneum irradiated females X non-irradiated males was greater for the 1500 r experimentals than for the controls; 3000 r resulted in 75% and 6000 r in 100% drop in productivity (assuming productivity of controls to be 100%). (2) The lethal effect of the high dosages of irradiation takes place at the egg stage. Mortality of larvae emerging from zygotes of irradiated males X non-irradiated females or from zygotes of the reciprocal cross is not greater than of larvae from unirradiated controls. (3) Dominant-lethal frequency generally increases with heavier irradiation until at 600 r 99% or more of the eggs fail to hatch. (4) Males of T. castaneum appear to be more sensitive to x-rays than females, and T. confusum males more sensitive than T. castaneum males: productivity of the latter was only 11.5% of the controls at 3000 r, and 0.5% at 6000 r; for T. confusum corresponding values were 8.0% and 0.2% of the controls. (5) The drop in productivity persists for at least one generation after exposure: T. castaneum controls produced 95 F_2 per female; F_1 of 3000 r irradiated males X non-irradiated females produced only 63 F_2 per female. Comparable values for T. confusum were 90 F_2 per female for the controls and 32 for the experimentals. (6) No sex-linked lethals were obtained. One visible mutant (pink eye) was probably induced by x-rays.

1215 Sokoloff, A. IRRADIATION EXPERIMENTS WITH Tribolium. Tribolium Inform. Bull. 4 (1961) 28-33.

The main effect of x-rays appears to be at the egg stage. Females are highly susceptible to high doses. Although they may survive at 6000 r to lay eggs, none of these proves viable. To study recovery phenomena, groups of males were exposed to 0, 3000 and 6000 r, and mated to non-irradiated females. T. confusum is more susceptible to 6000 r than T. castaneum. T. castaneum produces more offspring, and for a longer period; it may even recover after 8 weeks. After 3000 r, irradiated males of both species experienced the same recovery phenomenon, at the same time for both species. Throughout, data obtained are compared with those reported by Park et al. (Physiol. Zool. 31: 1958, 151). The above support and supplement the Park data. Post-irradiation fertility drops only to 70% as compared to 60.4% (Park), probably due to the fact that egg mortality increases if the eggs are not covered with flour, once they have been counted. No sex-linked lethals could be confirmed. A visible (pink eyes) mutation may have been induced by x-rays acting on the pre-meiotic stages of the irradiated female.

1216 Strømnaes, Ø. ARE THERE REAL STOCK DIFFERENCES IN X-RAY INDUCED MUTABILITY IN Drosophila melanogaster? Hereditas 50 (1963) 264-8.

Literature on the type and frequency of radio-induced mutations in Drosophila is reviewed with particular reference to the variations found among various strains. (NSA 18: 1964, 11733).

1217 Vorobtsova, I.E. COMPARATIVE STUDY OF RADIATION SENSITIVITY OF DIFFERENT STRAINS OF Drosophila melanogaster. Dokl. Akad. Nauk SSSR 153 (1963) 943-6. (In Russian).

The radiation sensitivity of 7 strains of wild type D. melanogaster was compared. In experiments with 50- to 500-kr irradiation doses, 100 kr was shown to be sufficient for 100% death of the flies in a time suitable for comparative studies. Averaged lifetimes of irradiated flies varied from 11.6 to 16.5 d; with statistically significant differences; the 7 strains were considered classifiable into 2 groups: one relatively radiation-resistant and the other, relatively radiation-sensitive. The curves of percentage of deaths versus time were similar for all strains, the rate increasing slowly at first, then very rapidly, but slowing down again near 100% mortality. These curves are considered to reflect not so much the differences in radiation sensitivity of individuals as differences in the processes causing destruction of the flies at different times after the irradiation. Coefficients of regression were calculated for the first two parts of the curves, and showed that the average length of life and rate of dying were inversely dependent in the 1st part but were not obviously related in the 2nd part. (NSA 18: 1964, 9851)

1218 Ward, C.L., Bowman, T., Burnham, D. GENETIC STUDIES OF Drosophila STRAIN DIFFERENCES IN SENSITIVITY OF THE TESTIS TO THE MUTAGENIC ACTION OF X-RAYS. (Abstr.) p. 156 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd., 1962.

Stocks of single chromosome interchanges between the Oslo and Iso-Amherst strains of Drosophila melanogaster were constructed in an effort to localize factors responsible for differences in sensitivity patterns. Comparative measurements of the rates of induction of sex-linked recessive lethal mutations by 2000 r of x-radiation were made on sequential samples of sperm from males of the stocks of X, second, and third chromosome interchanges between the two strains. The stocks were constructed in such a way as to bring the single chromosome of one strain through the male line, thus placing it in the cytoplasmic environment of the other strain. Third chromosome interchange stocks do not differ in sensitivity patterns from the Oslo and Iso-Amherst strains, i.e. the Oslo damage peak precedes the Iso-Amherst peak. In the X-chromosome interchange stocks the damage peaks coincide. There is a marked difference in peak level of damage between the second chromosome interchange stocks. The X-chromosome seems to have an effect on the time of the occurrence of the most sensitive cell stages, while the second chromosome affects the level of sensitivity.

1219 Ward, C.L., Bird, M.A. COMPARATIVE STUDIES OF CYTOCHROME C OXIDASE ACTIVITY AND MUTABILITY IN TWO STRAINS OF Drosophila. Genetics 47 (1962) 99-107.

A comparative study of the cycles of cytochrome c oxidase activity during pupal and adult life of two strains of Drosophila showed that the cycle of enzyme activity in the more rapidly developing strain precedes the slower strain, thus alternating the relationship of the enzyme activity during the time of development of the irradiated germ cells. The relationship of the differences in radiation sensitivity of the developing cells to the enzyme cycles is discussed. It was necessary to postulate at least two factors other than the protective effect of the cytochrome system in order to explain the entire sensitivity pattern of the two strains. (Auth.)

1220 Ward, C.L., Bird, M.A. CYTOCHROME OXIDASE ACTIVITY IN CHROMOSOME INTERCHANGE STOCKS OF THE OSLO AND ISO-AMHERST STRAINS OF Drosophila melanogaster. Genetics 48, 11 (1963) 1435-40.

This paper has been included since the genetic control of the cytochrome oxidase system, either directly or indirectly, is of considerable interest in relation to genetic sensitivity to irradiation. The numerous experiments indicating the effect of CO and cyanide poisoning on the genetic sensitivity to irradiation and the results of irradiation in O_2 certainly would suggest that some of the differences in level of genetic damage in strains and in cell types may well be determined by the activity of the cytochrome system. Cytochrome oxidase determinations on the chromosome interchange stocks of the Oslo and Iso-Amherst strains of D. melanogaster show that the activity level of the terminal oxidase system is generally higher in the strains carrying the Oslo second chromosome. However, the hemizygous Iso-Amherst X chromosome in the strain otherwise derived from the Oslo female seems to reduce the effectiveness of the Oslo second chromosome in producing an organisms with a higher level of cytochrome oxidase activity.

See also:

758 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, 1959)
772 The susceptibility of the rust-red flour beetle, Tribolium castaneum (Herbst.) to gamma radiation. (Crook, 1962)
805 Some effects of gamma radiation on the lesser grain borer (Rhizopertha dominica F.), tropical warehouse moth (Cadra (Ephestia) cautella Wlk.), Indian meal moth (Plodia interpunctella Hübn.), and the cigarette beetle (Lasioderma serricorne F.). (Pendlebury et al., 1962)
819 R-locus factor homologies in Mormoniella. (Whiting, 1962)
837 Differences in sensitivity to gamma radiation in Drosophila of the willistoni group. (Carvalho and da Cruz, n.d.)
864-6 Mutation rates at specific loci in Drosophila melanogaster. (Hannah-Alava, 1961, 1962)
894 Interspecific hybridization and gynogenesis in mealy bugs. (Nur and Chandra, 1963)
910 The mutation rate at specific autosomal loci in different species of Drosophila. (Turku Univ., Finland, n.d.)
940 Mutation rates at specific autosomal loci in different species of Drosophila. (Hannah-Alava, 1963)
947 Studies on the distribution of breakage sites of natural and radiation-induced chromosome dislocations in Drosophila subobscura Coll. (Kunze-Muehl, 1961)
982 Increased recombination from female Drosophila irradiated as larvae without oöcytes. (Whittinghill and Davis, 1961)
983 Unchanged recovery of crossovers after x-irradiation of pupal Habrobracon. (Whittinghill and Allen, 1961)
991 Contrasts in radiation-induced mutation rates at different meiotic stages. (Whiting, 1962)
1016 Spermatogenesis of the silkworm and its bearing on the radiation induced sterility. (Sado, 1961)
1024 Considerations on the changes in observed mutation rates in the silkworm after irradiation of various stages of gametogenesis. (Tazima, 1961)
1049 The effects of nitric oxide on radiation damage in Drosophila virilis and Drosophila melanogaster. (Capps, 1961)
1186 Virus-host relationship and the effects of x-ray induced mutants in heterozygous condition. (Baumiller, 1963)
1310 Changes in quantitative traits under selection and irradiation. (Bartlett, 1963)
1375 The importance of competitiveness of radiosterilized males in mosquito-control programs. (Dame and Schmidt, 1962)
1385 Research in genetics. (Stone, 1963)
1394 Restoration, without selection, of balanced genetic load by radiation of Drosophila inbred strains. (Cordeiro et al., 1963)
1497 Les possibilités d'emploi des radiations dans la lutte contre les insectes. (Nardon, 1963)
1499 Utilisation des radiations ionisantes (^{60}Co) pour la protection des denrées contre les insectes nuisibles. Recherches relatives à la détermination des doses utiles pour assurer la stérilité des insectes. (Pesson, 1963)

I-B Developmental Effects and Effects on the Organism

I-B-1 DEVELOPMENTAL STAGE RESPONSE. DELAYED DEVELOPMENT

I-B-1-a GENERAL

1221 Day, M.F., Oster, I.I. 2. PHYSICAL INJURIES. F. RADIATION. p.44-8 in "Insect Pathology. An Advanced Treatise. Vol.I". Steinhaus, E.A., Ed. New York, Academic Press. 1963.

The radio-resistance of adult, pupae and larvae of an insect is discussed. Sufficiently high doses of x-rays given at larval stages have been shown to (1) prolong the larval period, (2) produce phenocopies, (3) cause some deaths during the subsequent pupal or imaginal stages, and (4) reduce fertility in the surviving adults. Work in the field is cited.

1222 LaChance, L.E. EFFECTS OF RADIATIONS ON INSECTS. Proc. N. Cent. Br. ent. Soc. Amer. 17 (1962) 11-14.

Some of the variables affecting the results of radiation treatments are discussed. The female of Cochliomyia hominivorax (Coquerel) has proved ideal for determining the correlation between reproductive development and radiosensitivity. All eggs develop synchronously so that all are irradiated at the same stage of development (very different from the case of Habrobracon juglandis (Ashmead)). From studies on these two insects belonging to very different species from different orders, and from many other studies two general conclusions may be drawn: (1) development of the ova can be inhibited more easily if radiation treatment is administered in that sensitive period of endomitotic growth during which the nurse cells are becoming polyploid, and (2) once the oöcytes have differentiated, their development is not readily arrested by even large doses of radiation, but egg hatchability will depend on the meiotic stage of the nucleus at irradiation. In the irradiation of males, the relative sensitivity of the various stages of development poses similar problems. It also remains to be determined whether sterility is due to: (1) gametes containing dominant lethal changes but retaining motility and vigour, (2) inactivation of the sperm, or (3) damage to the immature cells to such an extent that mature sperm are not produced at all. Fractionation, dose rate and temperature also affect the results of irradiation, and particular environmental atmosphere may act as radiation protector or enhancer.

1223 Алимджанов, Р.А., Султанходжаева, З. ВЛИЯНИЕ ГАММА-ЛУЧЕЙ НА РАЗВИТИЕ ПОЧВООБИТАЮЩИХ НАСЕКОМЫХ. Докл. АН Узб. ССР 1 (1962) 59-60. Р. Ж. Биол. № 8Е3. 1963.

Alimdzhanov, R.A., Sultankhodzhaeva, Z. EFFECT OF GAMMA RADIATION ON THE DEVELOPMENT OF SOIL INSECTS. Dokl. Akad. Nauk Uzb. SSR 1 (1962) 59-60. R. Zh. Biol. No. 8E3. 1963.

Eggs of curculios of the genus Sitona were irradiated with Co^{60}; 3.3% of the eggs failed to develop at doses of 1000 r, with 7.4% of the eggs producing larvae. About 9% of the eggs perished outright at doses of 3000 to 10 000 r, with larval development entirely absent. A total of 1.4% of the eggs failed to develop in the control group, while 16.5% produced larvae. (BA 45: 1964, 40631)

1224* Арифов, У.А., Гуманский, Г.А. и др. ДЕЙСТВИЕ ГАММА-ЛУЧЕЙ НА ЖИВЫЕ КУКОЛКИ ТУТОВОГО ШЕЛКОПРЯДА. Докл. АН Узб. ССР 4 (1957) 9-12.

Arifov, U.A., Gumanskii, G.A. et al. EFFECT OF GAMMA RADIATION ON LIVE COCOONS OF THE MULBERRY SILKWORM. Dokl. Akad. Nauk Uzb. SSR 4 (1957) 9-12.

1225 Babos, L., Gubicza, A., Lukacsovics, F., Molnar, I. EFFECT OF GAMMA-RADIATION (Co^{60}) ON THE PUPAE OF Bombyx mori L. Tihany. Biol. kul. Int. Evkon. 29 (1962) 3-9. (In German).

1226 Balock, J.W., Jr., Burditt, A.K., Christenson, L.D. EFFECTS OF GAMMA RADIATION ON VARIOUS STAGES OF THREE FRUIT FLY SPECIES. Citrus Ind. 44, 8 (1963) 9-12.

Dacus dorsalis, D. cucurbitae, and Ceratitis capitata are considered.

1227 Balock, J.W., Jr., Burditt, A.K., Christenson, L.D. EFFECTS OF GAMMA RADIATION ON VARIOUS STAGES OF THREE FRUIT FLY SPECIES. J. econ. Ent. 56, 1 (1963) 42-6.

Radiation effects on development of eggs, larvae, and pupae were determined for the oriental fruit fly (Dacus dorsalis Hendel), the melon fly (D. cucurbitae Coquillett), and the Mediterranean fruit fly (Ceratitis capitata (Wiedemann)). Increasing dosages were required to prevent hatch as eggs became more mature except that eggs about 1/3 developed were more sensitive than younger ones. The LD_{95} for hatch of newly laid eggs was about 1300 r and for nearly mature eggs from 86 000 to 125 000 r. Pupation was reduced by 95% when eggs were exposed to 13 000 r and 1-d-old larvae to 30 000 r. More than 160 000 r was required to prevent pupation of mature larvae. Dosage required to prevent 95% emergence of adults was 6500 r or less when eggs, larvae, or 1-to 3-d-old pupae were irradiated. Older pupae became more resistant to radiation, and when fully developed required more than 100 000 r to prevent emergence of adults. Emerging adults were sterile after exposure as mature pupae to 10 000 r. Adults from 1st-instar larvae exposed to 2500 r developed and laid eggs but hatch was reduced 64% in the parent stock and pupation 36% in the F_2 generation. When irradiated in water, 100% CO_2, or N_2, the effect on eggs and larvae was 40% to 47% less than in air. The results suggest the feasibility of use of comparatively low dosages in the range of 15 000 to 20 000 r as a quarantine treatment for fruit fly-infested fresh fruits and vegetables. (Auth.)

1228 Banham, E.J. THE SUSCEPTIBILITY OF THE CONFUSED FLOUR BEETLE (Tribolium confusum Duv.) TO GAMMA RADIATION. AERE-R-3888, United Kingdom Atomic Energy Authority, Research Group, Isotope Research Div., Wantage, Berks., England. 1962. 32p.

The susceptibility to γ-radiation from Co^{60} of all developmental stages of T. confusum was examined under controlled environmental conditions, (in a culture medium of 30°C and 60% relative humidity, at 4000 r/h) with respect to the emergence of adults, survival and production of progeny. T. confusum is more resistant than Sitophilus granarius to the killing effects of γ-radiation but more susceptible to radiation sterilization. A dose of 16 000 rads, evaluated for complete sterilization of grain and rice weevils, is equally effective for the control of T. confusum.

1229 Bartlett, A.C., Bell, A.E. RADIATION EFFECTS ON REPRODUCTION IN PLATEAUED AND UNSELECTED STRAINS OF Tribolium castaneum. (Abstr.) Genetics 46, 8 (1961) 850.

The effects of various levels of x-radiation on reproductive fitness of a plateaued population of T. castaneum and its unselected base population were investigated. The plateaued population had been selected for increased body weight for 44 generations and weighed approximately 5500 μg in contrast to 2100 μg for the unselected strain. Two components of fitness (eggs laid during a standard 48-h period and number of resulting progeny) were observed. While the two strains did not differ in egg production, the unselected strain had superior hatchability. Within each of 9 doses (ranging from 200 r to 5000 r) the beetles were partitioned so that in one set only males were irradiated, in another set only females and in the third both males and females were irradiated. Irradiation of males was shown to have no effect on the ability to excite egg laying in their mates, but number of progeny was reduced with the higher doses. Egg production was not affected for doses up to 1000 r applied to females but a marked decrease was seen beyond that level. A decline in number of progeny from irradiated females was observed at doses as low as 600 r. The initial superiority of the unselected strain for number of progeny persisted over-all doses. A linear response to irradiation was not shown for either egg production (somatic effects) or number of pupae hatching (somatic effects and dominant lethal effects) for the dose range employed in this study.

1230 Bartlett, A.C., Bell, A.E. THE EFFECT OF IRRADIATION ON REPRODUCTION IN TWO STRAINS OF Tribolium castaneum Herbst. Rad. Res. 17 (1962) 864-77.

The effects of x-radiation on the reproductive performance of two strains of T. castaneum were measured. The two strains differed in body weight, one strain being 2½ times as heavy as the other. Females of the heavier strain were more resistant to somatic damage than were females of the light strain. Genetic damage, as measured by a reduction in fertility of irradiated individuals, was not so great in the heavy strain as in the light strain, especially when both parents were irradiated. When only one parent in a mating was irradiated, no sex differences in response to increasing dose were found. The effect of irradiating both parents can be predicted from the results obtained when only one parent is irradiated. The response curve for somatic damage showed a linear decline at high doses (1000 and 5000 r) but no significant effect at low doses (0 to 800 r). The response curve for genetic damage, as measured by an orthogonal polynomial analysis, was sigmoid in shape with a linear decline at low doses and a curvilinear decline at the high doses. The genetic response curve over all doses can be fitted to a function of the type

$Y = a + bX + cX^2$, where the different coefficients of X and X^2 change with the strain. The coefficients also depend on whether one or both parents are treated. The drop in fertility at doses over 5000 r was an average of 66.9% for irradiated foundation adults (summed over mating combinations) and an average of 58.8% for irradiated selected adults. (From Auth.)

1231 Baumiller, R.C. PREPUPAL EFFECTS OF X-RAY-INDUCED, EUPLOID AND NEAR-EUPLOID MUTANTS IN HETEROZYGOUS CONDITION IN *Drosophila melanogaster*. (Abstr.) *Genetics 46*, 8 (1961) 850.

The effect of euploid and near-euploid heterozygous mutants in *D. melanogaster* has already been studied in the egg and larval stages separately. The present work studies both stages in the same individual in order to estimate the minimal total effect of such mutants. Wild-type, Oregon-R males were treated (I) or not (C) with 3000 r of x-rays and mated to virgin, untreated, sibling females. Eggs were collected at $\frac{1}{2}$-h intervals, and each hour, starting the 21st hour after oviposition, the numbers of larvae hatching were scored. Of all larvae, the percentages hatching late (more than 1 h after the largest hourly percentage hatched in C) were: C, 2.9 ± 0.3 (of 2950 larvae); I, 8.8 ± 0.9 (of 1057 larvae). The induced difference in delay, of 6.1 ± 0.9%, is attributable to newly arisen (near-) euploid mutants in heterozygous condition. Not-delayed larvae (obtained from the hour when the largest percentage hatched in C) and delayed larvae were studied for retarded pupation and for death before pupation. The induced difference between not-delayed C and I was 9.7 ± 0.8% for retarded pupation and 6.7 ± 0.7% for death before pupation. Among delayed larvae the induced difference between C and I was 23.6 ± 0.7% and 19.4 ± 0.7%, respectively. Thus, about 16% (6.1 + 9.7) of the larval population which carry x-ray-induced, euploid and near-euploid, heterozygous mutants show a detrimental effect of these mutants in either the egg or the larval stage, of which approximately 1.4% were affected in both stages.

1232 Baumiller, R.C. THE EFFECTS OF X-RAY-INDUCED EUPLOID AND NEAR-EUPLOID MUTANTS IN HETEROZYGOUS CONDITION UPON DEVELOPMENTAL STAGES OF *Drosophila melanogaster*. *Diss. Abstr. 22* (1962) 2950-1.

This study required the development of techniques by which the duration of the egg and larval stages as well as the ability of larvae to pupae could be employed as criteria for detecting these heterozygous effects. In interstrain crosses these mutants were found to produce delay in pupation in about 9% of larvae under nutritional stress, and the killing of approximately 6%. The effect was less, about 7% delayed and 5% killed, when there was excess nutrient. Irradiation of sperm or oöcytes caused approximately equal amounts of detriment, doubtless partly by different types of mutation; no effect of delay or death in the larval stage was detected when oögonia were irradiated. In interstrain crosses about 5% of all hatching larvae were delayed in the egg stage by the mutants produced by x-raying P_1 males who were mated to sibling females. Of larvae not delayed in the egg stage, about 10% were delayed in the larval stage, of which 70% were killed. Of all larvae hatching, about 15% showed an effect in either the egg or the larval stage, while 1.4% were affected in both stages. After males from stocks containing heavier than normal genetic loads were irradiated, a greater than additive effect of heterozygous mutants was noted upon egg hatching. Thus, newly induced heterozygous mutants produced about 15% of effect when added to the heavier genetic load, but produced only about 1/4 this effect when added to the smaller (normal) load. The detrimental effects of euploid or near-euploid mutants in heterozygous condition detected were quite large. No evidence was found in support of the balance hypothesis of heterozygote advantage. However, all the results obtained could be explained by the classical hypothesis.

1233 Baumiller, R.C. DEVELOPMENTAL EFFECTS OF X-RAY INDUCED EUPLOID AND NEAR EUPLOID MUTANTS IN HETEROZYGOUS CONDITION IN *Drosophila melanogaster*. I. DELAY IN EGG HATCHING AND LARVAL DELAY AND DEATH PRIOR TO PUPATION. *Genetics 48*, 2 (1963) 263-71.

D. melanogaster males were treated with 3000 r x-rays, and the first released sperm were used to produce the F_1. The F_1 that hatched from the egg comprised the population studied with respect to time of egg hatching and delay and death prior to pupation. Results of the egg-hatching experiments were analysed by 2 methods. By the first, the curves were compared with respect to only one extreme. This showed a radiation-induced effect of about 6.1% more individuals with delayed egg hatching. The second method of analysis compared the total curves, and indicated a radiation-induced delay in egg-hatching time in about 20% of the larvae. The effects of delay and death studied here are attributed to euploid and near-euploid mutants in heterozygous condition. The basis for this conclusion is discussed briefly, as is the relation of these results to the detection of a heterotic effect of x-ray induced mutants.

1234 Beck, J.S. EFFECTS OF RADIATION UPON DEVELOPMENT OF *Tribolium confusum*. (Abstr.) *Rad. Res. 14* (1961) 449-50.

T. confusum, a holometabolous beetle, was chosen as a convenient system for the study of development and of aberrations in development produced by irradiation. Dose-response studies have repeatedly demonstrated the onset of induced deformity in wings (adults) at 500 r and a maximum incidence of 96% at 2000 r, with smoothly varying incidences at intermediate doses. Irradiation of pupae at various ages during the 7-d pupal life has revealed a sharp fall in deformity incidence over an age span of a few hours for pupae irradiated beyond a sensitive period in development. Experiments are under way to determine an onset in larval life of this particular radiosensitivity. Other experiments have been designed to locate the sensitive site within the organism by means of collimated beams of x-rays and by utilizing the Bragg peak of heavy ion beams. Current experiments have revealed no definite inheritance of the induced deformities. (From abstr.)

1234-a Beck, J.S., Manney, T.R. NEUTRON ACTIVATION ANALYSIS FOR PHOSPHORUS IN A STUDY OF DEVELOPMENT IN A BEETLE WING. *Science 137* (1962) 865-6.*

In order to quantitate differences between normal and radiation-induced wings at different stages of development, a method was developed for reproducibly isolating the (< 20 μg) membranous wings of *Tribolium confusum*. Neutron activation analysis was used to measure P in individual beetle wings during pupal and early adult stages. By counting neutron-induced P^{32} radioactivity it was possible to measure 0.005 ± 0.001 μg of P. The P content of the wings rises to maximum at eclosion and subsequently decreases with loss of cells.

1235 Brande, J. van den, Woestijne, N. van de EFFECT OF GAMMA-RADIATION ON THE MEDITERRANEAN FLOUR MOTH *Ephestia kuehniella* Z. IN DIFFERENT STAGES OF DEVELOPMENT. p. 563-7 in "XI. Internationaler Kongress für Entomologie, Wien, 17. bis 25. August 1960. Verhandlungen. Band II (Symposien)". Wien, Organisationskomitee des XI. Internationalen Kongresses für Entomologie, Wien 1960. 1962. (In English).

A Co^{60} source was used; 20 pairs consisting of a treated male pupa and an untreated female were used per dose. The influence of γ-rays in the pupal stage was tested on male pupae aged 15, 12, 9, 6, and 3 d. A 60 000 rad dose results in complete sterility of the male; 20 000 rad produce 50% and 40 000 rad 93.7% sterility, the sterility produced gradually increasing with dosage rate. The younger the pupa at the time of irradiation, the greater the effect. At 6 d, complete sterility is produced by 30 000 rad and no copulation occurs after 40 000 rad. At 3 d, no offspring is produced from 10 000 rad onwards. All males have a shrivelled appearance and their life span is much reduced. After irradiating fully grown female pupae with 60 000 rad, the emerging adult females do not accept copulation and no eggs are laid. Experiments with full grown larvae, 17-d-old larvae and 4-d-old eggs indicated that dosage rates < 2500 rad do not seem to have any unfavourable effects; that some slight damage occurs (apparent mostly in the F_1 generation) above 4500 rad; and that pupation occurred only to a very limited extent on irradiating full grown larvae with 9000 rad, and not at all after 18 000 rad.

1236 Brownell, L.E., Yudelovitch, M. EFFECT OF RADIATION ON MEXICAN FRUIT-FLY EGGS AND LARVAE IN GRAPEFRUIT. p. 193-201 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

A limited study has been made of the effect of γ-radiation from Co^{60} on the eggs and larvae of the Mexican fruit fly, *Anastrepha ludens*. Various doses from 5000 to 90 000 rad were given to fruit 1 and 12 d after infestation to explore the effects of irradiation on the egg and 1st-instar larval stage. Fruit containing fully grown larvae and larvae at intermediate stages was also irradiated with similar doses. Frequent examination and dissection of the fruits were used to determine larva mortality, larval damage to fruits, presence of pupae and presence of adult flies. Dissected fruits given radiation doses of 5000 rad or more during the egg or 1st-instar stage revealed no insects or trace of insect damage. Fruit infested with adult larvae produced numerous pupal recoveries but no adults emerged from pupae recovered from fruits receiving 5000 rad or more. It is concluded that a γ-radiation dose of 5000 rad (and possibly less, based on limited tests of 2000 rad) will break the life-cycle of the fly although the larval stage may survive appreciably greater dosages. A design for a railway mobile γ-irradiator for treating infested fruits is proposed. (From auth.)

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* See previous reports of work in UCRL-10389 and -10683, California, Univ., Berkeley.

1237 Bull, J.O., Wond, T. CONTROL OF THE MEDITERRANEAN FLOUR MOTH *Anagasta kühniella* Zell BY STERILE MALE RELEASE. II. SUSCEPTIBILITY TO GAMMA RADIATION. AERE-R-3967, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks., England. 1963. 42p.

The susceptibility of all developmental stages was studied. Eggs 0-24 h old were the most susceptible stage, another at the transition from larva to pupa (32 d). Total emergence was reduced as the dose increased in all age groups (up to 36 d), and development retarded throughout up to 32 d, the degree of retardation depending on dose. Wing deformities occurred throughout up to 36 d, particularly between 10 000 and 12 000 rads. Females were most sensitive at 30 d. Increasing resistance resulted in equal or even greater longevity of irradiated females versus controls. Males were more resistant to sterilization than females, at all stages of development (sterilizing doses: 25 000 rads and 45 000 rads for female and male pupae, respectively). Percentage mating was reduced by radiation in all groups up to 36 d. The optimum age and dose for sterilization while retaining near normal longevity and mating behaviour were worked out. Susceptibility in general decreased as age increased but young pupae were more susceptible than old larvae, pupae on the point of eclosing being least susceptible. The use of the sterile male technique to control moth infestations of flour mills is precluded by economic and ecological considerations.

1238 Carney, G.C. SOME EFFECT OF GAMMA RADIATION ON THE BIOLOGY AND MORPHOLOGY OF THE KHAPRA BEETLE, *Trogoderma granarium* Everts. *Proc. N. Cent. B. ent. Soc. Amer.* 17 (1962) 31-2.

Subjecting larvae and young pupae to a dose of 10 000 r of γ-radiation interfered with their normal metamorphosis. The extent of the damage incurred (mostly in the form of incomplete sclerotization of the elytra, arrested wing development, reduction of ovarioles, absence of eggs) depended on the age of the pupae at the time of irradiation. Irradiation of pupae of *Tenebrio molitor* had very similar effects on the adults, resulting in deformed and unsclerotized elytra and a retention of pupae characters in the abdomen. Difficulties in interpretation and further research required are discussed.

1239 Chatterji, S., Rattan Lal, Rahalkar, G.W., Sethi, G.R., Saxena, P.N. STUDIES ON THE EFFECTS OF BETA RADIATIONS ON INSECTS. III. THE EFFECT OF BETA RADIATIONS (IRRADIATION OF EGGS) ON THE DEVELOPMENT OF *Dysdercus koenigii* Fabricius. *Indian J. Ent.* *22* (1961) 40-5.

With increase in dose the viability of the eggs decreased. When the eggs were subjected to a total dose of 100 r given over 6 different exposure periods ranging from 1 to 24 h embryonic mortality was more in longer exposure periods than in shorter ones. When adults which emerged from 1, 2, and 4 h exposure periods were mated separately, the females laid more eggs than those laid in the control. However, their viability was lower than that in the latter. When the treated females were mated with normal males they laid more eggs than those mated with males from the corresponding treatment and the viability of these eggs was also greater. (BA 41: 1963, 4622)

1240 Dennis, N.M. EFFECT OF CATHODE-RAY IRRADIATION ON THE RICE-WEEVIL IN WHEAT. *US. Agric. Marketing Res. Rep.* *531* (1962) 1-14.

1241 DeFries, J.C., Touchberry, R.W. GENETIC EFFECTS OF γ-IRRADIATION ON THE PERCENT ADULT EMERGENCE OF *Drosophila melanogaster*. (Abstr. 5, 64) p. 77 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Newly emerged males and females from two populations (randombred and inbred) derived from Luce's wild type strain were subjected to various dosages of γ-irradiation (0, 500, 1000 or 1500 r) and mated in all possible combinations within populations, resulting in a four × four factorial arrangement of treatments. Three mating pairs were included in each subclass of two replicate experiments, requiring a total of 96 mating pairs per generation in each experiment. Eggs were collected over a 10-d period following treatment and the percent of the offspring to emerge as adults was determined. In addition to these data of generation 1 (offspring of treated flies), similar data were obtained for generations 2 and 3 resulting from full-sib matings of generations 1 and 2, respectively. Somatic and genetic effects would be expressed in generation one, whereas only genetic effects would be expressed in subsequent generations. Highly significant linear depressing effects resulting from treatment of both males and females were observed in the data of generation 1, with the magnitude of the effect being greater for males than females. Highly significant effects resulting from treatment of the original males, although smaller in magnitude than in the 1st generation, were again found in the data of generations 2 and 3; however, no effect was evident from treatment of the original females in these later generations.

1242 Dixon, E.B. SOME EFFECTS OF IRRADIATION ON *Cochliomyia hominivorax*. *J. econ. Ent.* *55*, 6 (1962) 826-7.

Pupae of *C. hominivorax* (Coquerel), 1-, 29-, 52-, 76-, and 97-h of age, were exposed to equal multiple and single doses of irradiation varying from 600 to 7800 r x-rays. Newly emerged eggs were exposed for 1-, 2-, 3-, and 4-min at 531 r/min. Five-hour-old eggs were exposed in minute intervals from 1 to 15 min at 539 r/min. Unfertilized ova and sperm were exposed to 531 r, 600 r, and 1062 r by irradiation of 8-d-old flies. Generally multiple irradiation was more harmful to pupae than an equal single dose. Unfertilized eggs seemed more susceptible to radiation than newly laid eggs. Five-hour-old eggs appeared less susceptible than unfertilized or newly laid eggs. (Auth.)

1243 Ducoff, H.S., Bosma, G.C. RESPONSE OF *Tribolium confusum* TO RADIATIONS AND OTHER STRESSES. p. 83 in "XVI International Congress of Zoology, Washington, 20-27 August 1963. Vol. 2". Moore, J.A., Ed. Washington D.C., XVI International Congress of Zoology.

A number of workers have examined the acute lethal responses of x-irradiated *Tribolium* adults; the midlethal dose (MLD) range is 6 - 12 kr. Our laboratory's investigations reveal a MLD for larvae of 2.5 - 5 kr; x-irradiation of larvae leads to two other effects, a delay in pupation and, when very late larval stages are irradiated, morphological abnormalities in the resulting adults. First day pupae are about as sensitive as larvae, but by the 3rd day, pupae are as resistant as adults. Eggs are more sensitive than larvae, and the sensitivity of the egg is an inverse function of its age: 2 kr causes 100% lethality in eggs less than 24 h old. In addition, sublethal irradiation of eggs markedly inhibits the subsequent rate of growth and development. X-ray effects on eggs and on pupae are mimicked by ultraviolet radiation; larvae, however, appear less sensitive than adults to the stress of high oxygen pressure. A demonstration included the dose-response curves of the various stages of the life cycle, examples of the induced developmental abnormalities, and a simple apparatus for exposure to high oxygen pressure. (Essentially auth. abstr.)

1244 Erdman, H.E. ARRESTED DEVELOPMENT IN X-RAYED LARVAE OF *Ephestia kuehniella* Zeller (LEPIDOPTERA: PHYCITINAE). HW-SA-2281, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 1961. 8p.

Arrested development was induced by massive doses of x-rays in *Ephestia* larvae and biological interpretations are proffered. Adverse influence upon neurosecretory interactions and/or upon the imaginal discs was demonstrated. No genetically explainable effects were noted between the sexes. The instantaneous lethal dose for larvae within 3 to 5 d of pupation is in excess of 50 kr. For most practical purposes death occurred at 15 kr because at this dose and those higher further development ceased. Increased incidence of disease, apathy toward food, lethargy, uncoordinated movements when probed, and wing abnormalities were other radiation induced effects noted. (Auth.)

See also 1250.

1245 Erdman, H.E. DEVELOPMENTAL ARREST OF IRRADIATED *Ephestia* LARVAE. p. 102-3 in "Hanford Biology Research Annual Report for 1961." HW-72500, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 15 Jan. 1962.

Massive doses of x-rays (20 kr or more) to moth larvae caused irreversible developmental arrest. Various radiation-induced effects were observed. Damage to mitotically active imaginal discs and/or to the neurosecretory complex was implicated. (Auth.)

1246 Erdman, H.E. X-RAY EFFECTS ON DIFFERENT LIFE STAGES OF TWO FLOUR BEETLE SPECIES (*Tribolium confusum*, *Tribolium castaneum*). Summer Meeting of American Society of Zoologists, Oregon State University, Corvallis, Oregon, August 1962. *Amer. Zool.* *2*, 3 (1962) 407.

1247 Erdman, H.E. COMPARATIVE X-RAY SENSITIVITY OF *Tribolium confusum* AND *T. castaneum* (COLEOPTERA: TENEBRIONIDAE) AT DIFFERENT DEVELOPMENTAL STAGES DURING THEIR LIFECYCLE. *Nature*, Lond. *195* (1962) 1218.

The x-ray sensitivities of two ecologically similar species of flour beetles were compared at 8 different ages in the life cycle. The doses required to induce sterility and lethality were determined. The egg was found to be the most radiosensitive stage, and *T. confusum* was consistently more radiosensitive than *T. castaneum*. Radiosensitivity was approximately constant during the larval stages, but it increased for the 15-d-old larval stage of *T. castaneum* and dropped back to normal thereafter. (NSA 16: 1962, 31525)

1248 Erdman, H.E. BEGINNING OF REPRODUCTION DETERMINED BY AGE OF THE FEMALE FLOUR BEETLE, Tribolium confusum (COLEOPTERA: TENEBRIONIDAE). HW-SA-2576, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 9 May 1962. 5 p.

Adult males of the confused flour beetle, T. confusum, were fertile within 24 h of eclosion whereas females were fertile after the 6th day of adult life. To determine the influence of environmental factors on all stages of oögenesis it was therefore necessary to use adult females at least 9 d old. Developmental differentiation and degree of reproductive-tissue differentiation determine not only the onset of fertility but also influence the radiotolerance of these cells and tissues. Various temporal sequences proposed by other authors are discussed, together with observations on differential radiosensitivity.

1249 Erdman, H.E. BEGINNING OF REPRODUCTION DETERMINED BY AGE OF THE FEMALE FLOUR BEETLE, Tribolium confusum (COLEOPTERA: TENEBRIONIDAE). Naturwissenschaften 49, 18 (1962) 428.

The daily fertility of different age combinations during the first 2 weeks of adult life is shown graphically. Males were fertile within 24 h after eclosion whereas pairs with young females were not fertile before day 6. Fertility values of old X old pairs were approached by old X young and young X young pairs by day 8 and 10, respectively. Old X old pairs were fertile day 1 and their fertility remained high through the experiment. Young X old pairs were fertile on day 1, their fertility decreased on day 2, and then gradually increased to old X old values by day 6.

See also 1248.

1250 Erdman, H.E. ARRESTED DEVELOPMENT IN X-RAYED LARVAE OF Ephestia kuehniella Zeller (LEPIDOPTERA: PHYSITINAE). Amer. Midl. Nat. 69, 1 (1963) 34-7.

See 1244 (same title and auth. abstract)

1251 Garsou, J.L. PRELIMINARY RESULTS ON THE EFFECT OF HIGH ENERGY PHOTONS ON LETTUCE ROOT GROWTH AND ON Musca domestica. (Abstr.) p. 5 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd, 1962.

The effect of the 40 kVp x-rays on lettuce roots has been studied, using mean relative growth rate of homogeneous groups of roots, or time of first growth depression, as measures of radiation response. Larvae of Musca domestica were also exposed to irradiation in 2 doses at 300 r/sec. When the percentage of larvae which form cocoons was plotted against dose in the 2nd irradiation (150-3000 r), curves were obtained which were displaced according to the 1st dose (150-900 r). When eclosion was taken as a measure of damage the same analysis gave groups of similar curves. Irradiation of cocoons of Musca domestica with two doses (150-600 r followed by 1500-1800 r) showed that the percentage of eclosion is related to the 1st dose in a manner independent of the interval (2-20 h) between the doses. (From abstr.)

1252 Ghosh, S.M., Hati, A.K. EFFECT OF GAMMA RADIATION ON THE FIRST INSTAR LARVAE OF Culex fatigans. Bull. Calcutta Sch. trop. Med. Hyg. 10, 3 (1962) 119.

1253 Hati, A.K., Ghosh, S.M. EFFECT OF GAMMA RADIATION ON MOSQUITOES: ANOMALIES IN DIFFERENT STAGES OF DEVELOPMENT. Bull. Calcutta Sch. trop Med. Hyg. 10, 1 (1962) 17-8.

1254 Henneberry, T.J., Sullivan, W.N. THE EFFECT OF GAMMA RADIATION ON SILKWORM EGGS. (Abstr. 275) Bull. ent. Soc. Amer. 8, 3 (1962) 166.

Silkworm (Bombyx mori (Linnaeus)) eggs 1, 4, and 7 d post diapause were exposed to various doses of Co^{60} γ-irradiation in single or fractionated dosages. Eggs in early post diapause were more susceptible to radiation than those in later stages of development.

1255 Henneberry, T.J., Sullivan, W.N. EFFECT OF GAMMA-RADIATION ON EGGS OF THE SILKWORM. Nature, Lond. 200 (1963) 1121-2.

Follow-up of work outlined in 1254. 1-, 4- or 7-d-post-diapause Bombyx mori eggs were exposed to a series of γ-radiation doses of 0.8 kr - 51.2 kr at 320 r/min. Exposure to 3.2 kr killed 100% of the 1-d (post-diapause) eggs but only 50 and 5%, respectively, of the 4-d and 7-d eggs. Similar results, but smaller differences, were obtained with 1.6 kr. Dosage mortality curves for 1, 4, and 7-d eggs are given. Mortality of 1- or 4-d eggs increased with increasing exposure, but no significant increase in mortality for the 0.8 - 3.2 kr range was found in 7-d eggs. Total exposures of 0.8 or 1.6 kr, delivered in 1 irradiation period, or 2 irradiation periods with $\frac{1}{2}$ the total dose administered at a time were equally damaging to 1-d eggs. A total of 1.6 kr delivered in fractions of $\frac{1}{4}$ the dose at 90-min intervals was less damaging than when administered in 1 or 2 periods. Exposure to 3.2 kr in 1, 2, or 4 irradiation periods led to 100% mortality of 1-d eggs.

1256 Hoover, D.L., Floyd, E.H., Richardson, H.D. EFFECTS OF 300 kV X-RAY RADIATION ON Sitophilus oryzae. J. econ. Ent. 56, 5 (1963) 584-6.

All developmental stages of the rice weevil, S. oryzae (L.), were subjected to radiation by x-rays at dosages ranging from 1000 r to 12 500 r. It was found that resistance to the effects from x-ray radiation exhibited by this species increased as development increased. Relative to adult emergence there was but little difference in resistance by pupae regardless of dosage administered. However, adult mortality following emergence correlated closely with dosage administered. The LD_{50} and the point of complete sterility for the adult stage were found to lie between 7500 r and 10 000 r. (Auth.)

1257 Hough, W.S. EFFECTS OF GAMMA RADIATION ON CODLING MOTH EGGS. J. econ. Ent. 56, 5 (1963) 660-3.

In 1957 and 1958 eggs of Carpocapsa pomonella (L.) were exposed to γ-radiation to establish a strain designated Va.-Gr. Most of the eggs were 4 d old when irradiated. During each of the next 4 seasons the Va.-Gr strain was reared through 2 generations on unsprayed apples. Principal effects on biological performance were (1) temporary increase in incubation period of the egg, (2) increase in average number of eggs deposited by Va.-GR females, and (3) slight increase in longevity of Va.-GR moths. Sensitivity to γ-rays declined with aging of the eggs. Susceptibility to DDT and lead arsenate was not altered by irradiating eggs 4 d old, but in 1962 increase in DDT resistance followed irradiation on Va.-GR eggs less than 1 d old. Susceptibility to weak concentrations of Guthion® (O, O-dimethyl S-(4-oxo-1, 2, 3-benzotriazin-3-(4H)-ylmethyl) phosphorodithioate) or Sevin (1-naphthyl N-methylcarbamate) was not a affected. (Auth.)

1258 Hsu, P., Li, C., Chen, H. THE EFFECT OF IRRADIATION WITH γ-RAY: Co^{60} ON THE DEVELOPMENT AND REPRODUCTIVE POWER OF Trombicula akamushi var. deliensis. Acta ent. sin. 12, 5/6 (1963) 578-85. (In Chinese, with English summary).

In experiments in China, exposure to γ-radiation from a Co^{60} source was found to affect the development of well-fed larvae of Trombicula deliensis Walch. The effect of treatment at 5000 r was indefinite, but higher doses decreased the number of nymphs obtained, and at 20 000 r almost all the larvae failed to give rise to nymphs. When the nymphs were irradiated, a dose of even 2500 r had a definite effect, and one of 20 000 r prevented the emergence of any adults. Observations on the reproductive ability of adults from treated immature mites showed that, within limits, the reduction increased with the dose applied, was greater when the treated individuals had not fed, and decreased with increasing age at time of treatment. Irradiation was most effective when applied to unfed larvae and almost ineffective when applied to engorged adults. (RAE-B 52: 1964, 137)

1259 Йирковский, Г.Г. ВЛИЯНИЕ ИОНИЗИРУЮЩЕЙ РАДИАЦИИ НА РАЗВИТИЕ НЕКОТОРЫХ НАСЕКОМЫХ. Стр. 85-6 в сб. "Тезисы 3-ей Всесоюзной конференции молодых ученых-биологов". М. 1961.

Iirkovskii, G.G. EFFECT OF IONIZING RADIATION ON THE DEVELOPMENT OF VARIOUS INSECTS. p. 85-6 in "Papers presented to the Third All-Union Conference of Young Biologists", Moscow, 1961.

1260 Japan. Sericultural Experiment Station, Tokyo. STUDIES ON THE BREEDING METHOD TAKING ADVANTAGE OF γ-RAYS IN THE SILKWORM. Nucl. Sci. Abstr., Japan 2, 2 (1963) 132-3 (In English).

Physiological damage from γ-irradiation is reduced if the insect is maintained at low temperature (post-irradiation); the longer it remains at low temperature the less damage occurs. This is true for irradiation at the embryonic and the pupal stages. To obtain an equivalent effect at 15°C post-irradiation and at 25°C at least double the dose is required with 15°C. Five F_1-hybrids were reared at 5 different stations and tested. Small relative differences in viability existing among controls were greatly increased on irradiation. It may be possible to predict differences in viability for the whole life-cycle (post-developmental stages, etc.) from the extent to which hatchability is reduced by γ-irradiation.

1261 Jefferies, D.J. THE SUSCEPTIBILITY OF THE SAW-TOOTHED GRAIN BEETLE, Oryzaephilus surinamensis L. TO GAMMA RADIATION. AERE-R-3891, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks., England. 1962. 32p.

An investigation was made into the susceptibility to γ-radiation of eggs, larvae, early and late pupae and adults of O. surinamensis, to examine the efficiency of 16 000 rads for radiation disinfestation of grain. Doses of 9600, 8600, 14 400, 30 800 and 20 600 rads are required, respectively, for 99.9% reduction in survival. Production of progeny was reduced by 99.9% by 8000, 6500, 7700, 12 000 and 15 300 rads, respectively. Calculations show that, under the conditions investigated, 16 000 rads control O. surinamensis for a period of 9 weeks. Several factors are discussed which suggest that this is likely to be the minimum possible degree of control effected by 16 000 rads. It is likely to be more effective in practice. (Auth.)

1262 Johansen, I. STUDIES ON THE RADIATION SENSITIVITY OF Drosophila EMBRYOS. (Abstr.) Hereditas 48, 3 (1962) 543-4.

The radiation sensitivity of the Drosophila embryo has been studied in relation to age of embryo, dose rate, and dose fractionation. The dose response curves for different ages show differences both in LD_{50} level, and in the shape of the dose response curve. Extrapolation numbers have been estimated by fitting theoretical curves to the experimental points. Dose rate effects have been studied by means of 60 ± 5 min-old eggs. It was found that although the LD_{50} shows very little change, the estimated extrapolation number does change with dose rate. In experiments where the x-ray beam was interrupted by means of a rotating slotted steel disc, it was found that the O_2 enhancement ratio was unchanged when compared with continuous irradiation, indicating that the efficiencies of O_2-dependent and O_2-independent mechanisms of radiation damage are not changed when the radiation is delivered in pulses of 40 μsec duration.

1263 LaChance, L.E. RADIOSENSITIVITY OF THE VARIOUS STAGES OF OOGENESIS IN Callitroga hominivorax. (Abstr.) Genetics 46, 8 (1961) 877.

The female reproductive system of this insect affords an ideal opportunity to study a large number of germ cells all of which are in the same stage of oögenesis. The female usually will not oviposit until 7 d old. During this time approximately 250 germ cells are undergoing growth and maturation, each in a separate ovariole. Virgin females ranging in age from a few hours to 7 d old were irradiated with 2650 r of γ-radiation, then mated to untreated males and egged when they were 8 d old. At this time the females deposited approximately 250 eggs. Failure of the eggs to hatch was attributed to dominant lethal changes induced in the oöcyte. Radiosensitivity of the developing oöcytes varied considerably. Irradiation of the females less than 4 h old resulted in complete sterility. Mature oöcytes were not formed. Observed hatchability for the other age groups was females 18-24 h old, 30%; more than 24 h old, 60%; 2 d old, 64%; 3 d, 76%; 4 d, 30%; 5 d, 14%; 6 d, 21%; and 7 d, 17%. Cytological investigations of the ovarioles indicated that the high radiosensitivity during the 1st day corresponds to changes taking place in nurse cell nuclei during the first 24 h of adult ovarian growth. Trophocyte units are completely differentiated after 24 h and this confers a degree of radioresistance to the oöcyte-trophocyte group. After the 3rd day the oöcyte is almost fully mature and nurse cells have disappeared. Increased radiosensitivity of the oöcyte on the 4th day, and after, is then due to changes taking place within the oöcyte nucleus.

1264 LaChance, L.E., Leverich, A.P. RADIOSENSITIVITY OF DEVELOPING REPRODUCTIVE CELLS IN FEMALE Cochliomyia hominivorax. Genetics 47, 6 (1962) 721-35.

In female Cochliomyia hominivorax, γ- radiation-induced dominant lethal changes in the reproductive cells (which develop synchronously) were measured by egg-hatchability tests and correlated with cytological observations of the stage of nuclear development. (1) In pupae 4-6 d old, only oögonial cells are present. Irradiation at this age reduced the number of mature oöcytes produced as the dose increased, but the lowered hatchability of eggs that were produced indicated that some dominant lethals persisted through maturation to be detectable in the embryo. (2) In old pupae and newly emerged adults, differentiation of the oöcytes and nurse cells takes place. Irradiation of adults less than 24 h old interfered considerably with egg production; the younger the female at irradiation, the fewer normal eggs were produced. (3) Irradiation of females older than 24 h resulted in production of normal numbers of eggs. In three-d-old females the oöcyte nucleus is in prophase I, in 4-d-old females metaphase I, and in 5-d-old females anaphase I. Dosage-response studies indicated that the LD_{50} radiation dose for oöcytes in metaphase I is 1309 r, anaphase I, 1639 r, and prophase I, 7939 r. For oöcytes irradiated in the first meiotic division, the relation between dose and dominant lethals induced was linear for the range investigated. (Essentially auth.)

1265 LaChance, L.E., Bruns, S.B. OOGENESIS AND RADIOSENSITIVITY IN Cochliomyia hominivorax (DIPTERA: CALLIPHORIDAE). Biol. Bull. 124, 1 (1963) 65-83.

In untreated Cochliomyia hominivorax females, (screwworm flies), gross ovarian growth correlated with the age of the adult female from emergence to sexual maturity was measured. The size of the ovary doubles between the 1st and 2nd day of adult life, increases more than 5-fold between the 2nd and 3rd day, and increases over 60-fold from emergence to sexual maturity. The cytology of the reproductive system, from 5-d-old pupae to sexually mature females is described. The effects of γ-radiation on gross ovarian growth indicated that newly emerged females are more radiosensitive than 5-d-old pupae, and that irradiation of 2-d-old females has little effect on subsequent ovarian growth. The cytopathology of the irradiated ovary was studied after similar doses of radiation were delivered to various developmental stages. The most radiosensitive stage encountered was that period during which the egg chambers contain nurse cells undergoing endomitotic replications of chromosomal material. (Auth.)

1266 Larsen, W.P. A STUDY OF THE EMBRYOLOGY OF THE COCKROACH, Blaberus craniifer BURMEISTER. Diss. Abstr. 21, 11 (1961) 3565.

In a study on the effects of x-irradiation on the embryos of Blaberus, dosages of 50 to 1000 r (from a 250 kV, 15 ma source) were administered to 26 gravid cockroaches containing developing embryos from 1-60 d old. After 30 d, embryos younger than 60 d were killed and fixed in Kahle's solution. The older embryos were allowed to complete their development. Whole mounts and paraffin sections were made of those embryos which, on gross observation, appeared to be affected by ionizing radiation. Although the oöthecal covering and the ovoviviparous habit limit the scope of some kinds of experimentation, Blaberus shows favorable possibilities for experimental embryology involving the developmental effects of radiation. The exploratory x-irradiation experiment of this study uncovered some pertinent facts. The younger the embryo, the smaller the amount of x-irradiation necessary to produce developmental effects. Dosages < 1000 r may have a sterilizing effect on developing germ cells. Specific abnormalities displayed after irradiation were dwarfing, inhibited growth in certain areas, restrained ventral flexure, and a change in the polarity of pleuropodial nuclei.

1267 Larsen, W.P. THE EFFECTS OF X-IRRADIATION ON THE EMBRYOS OF INVERTEBRATE ANIMALS. Progress Report. Period: May 1, 1961 to April 30, 1962. TID-14662, Division of Technical Information, AEC. 15 May 1962. 13p.

Gravid females of Blaberus craniifer Burmeister, carrying embryos 1 - 52 d old, were treated with x-rays. The younger the embryo, the lower the dosage required to cause morphological change. Embryos at <28-30 d are affected at < 700 r; embryos > 30 d suddenly show resistance and continue development until dosages reach a level comparable to the lethal dose for adults (adult females die within 30 d after > 5000 r. Gross abnormalities are found; they are varied, ranging from individuals slightly retarded in growth to embryos represented by an amorphous mass. Other abnormal features are described. Embryonic membranes, yolk cells, and the dorsal organ continue to grow and multiply even in the face of high level radiation sufficient to have arrested embryonic growth.

1268 Larsen, W.P. SOME EFFECTS OF X-IRRADIATION ON EMBRYOS OF THE COCKROACH Blaberus craniifer. Ann. ent. Soc. Amer. 56, 4 (1963) 442-8.

Gravid females of the ovoviviparous B. craniifer Burmeister were given x-ray dosages of 50 to 12 000 r, after which their included embryos were examined for changes in the growth of cells and tissues. Embryos were found to become resistant to x-irradiation suddenly just prior to the stage of dorsal closure. Embryos that had passed this stage when irradiated continued to develop normally until dosages reached levels of 2000 r to 5000 r. Extra-embryonic structures were found more resistant to irradiation than embryonic tissues. Cells of the serosa and dorsal organ continued to multiply after x-irradiation had stopped the division of cells in the embryo proper. (Auth.)

1269 Lassota, Z. ACTION OF γ-RAYS ON EGGS, LARVAE, AND PUPAE OF Bombyx mori. Acta biochim. polon. 10, 4 (1963) 379-86. (In English).

Bombyx mori were irradiated with single doses of γ-rays. A dose of 10 000 r given to purgating larvae or to 3-d old cocoons altered metamorphosis. The effect of 2500 r applied at the same stages was revealed only in the 2nd generation. A dose of 10 000 r given to the diapausing eggs inhibited completely the hatching of larvae, and doses of 2500 and 5000 r delayed the hatching of larvae and reduced their number, respectively, to 50% and 10% of the observed population. The high radiosensitivity of the egg and pupa stages in Leipdoptera persists, even though at these stages the metabolic activity is minimal owing to the diapause. (A 60: 1964, 5860 c)

1270* Лавров, М.Т., Богомаз, В.А. ВЛИЯНИЕ РАДИОАКТИВНОСТИ НА МАЙСКОГО ЖУКА. Защ. Раст. 6 (1958) ?-?

Lavrov, M.T., Bogomaz, V.A. EFFECT OF RADIOACTIVITY ON THE MAY BUG. Zashch. Rast. 6 (1958) ?-?

1271 Lefevre, G. Jr. THE INFLUENCE OF AGE AND MATING PATTERNS BEFORE AND AFTER IRRADIATION ON THE INCIDENCE OF INDUCED MUTATIONS IN Drosophila melanogaster. (Abstr.) Genetics 48, 7 (1963) 897-8.

Sex-linked lethal mutations were detected in successive broods following a 4000 r x-ray exposure of wild-type D. melanogaster males 2, 3, and 4 d old. In contrast with the usual procedure in mutation studies, each brood consisted of the progeny resulting from a single mating, and mutation frequencies were determined separately for successive matings during a period of several days after the irradiation. Further, some males were mated two or three times immediately before irradiation so as to diminish the store of fully mature sperm available upon expsoure. The results of these experiments indicate clearly that: 1) the mutation frequency in the very first sperm used following irradiation is higher than commonly realized; 2) in younger males the mutation frequency drops from mating to mating during the 1st day, but not so in older males; and 3) premating strikingly reduces mutation frequencies even in the first mating following irradiation. (Essentially abstr.)

1272 Legay, J.M., Teulade, P. SENSIBILITÉ AUX RAYONS X DE LA DURÉE DE DÉVELOPPEMENT DES OEUFS DE Bombyx mori LORSQUE L'IRRADIATION EST EFFECTUÉE QUELQUES HEURES APRÈS LE DÉBUT DE L'INCUBATION. C.R. Acad. Sci., Paris 255 (1962) 1784-5.

Les variations du temps de développement (le temps qui écoule entre le début de l'incubation et le moment de l'éclosion) en fonction des doses administrés ont été mesurées. Les oeufs étaient irradiés aux doses suivantes: 0 (témoin), 500, 1000, 2000, et 3000 r. Le temps de développement croît avec la dose. La mortalité ne diffère significativement de celle des témoins qu'à partir de 1000 r. La durée de développement se révèle un critère sensible aux faibles doses; par contre, aux fortes doses, la mortalité augmente beaucoup plus vite. Il paraît que le temps de développement d'une part, et le pourcentage de mortalité d'autre part, sont directement proportionnels aux logarithmes des doses, donc proportionnels entre eux. Si l'irradiation a lieu après 5 j d'incubation, il n'y a aucun accroissement du temps de développement alors que la mortalité est très significativement supérieure à celle des témoins.

1273 Mossige, J. INVESTIGATIONS OF RADIOSENSITIVITY DURING SPERMIOGENESIS IN Drosophila melanogaster. p. 20-2 in "Fourth Report from Norsk Hydro's Institute for Cancer Research for 1961 and 1962". Oslo. Norsk Hydros Institutt for Kreftforskning. 1963.

See 1087. The difference in radiosensitivity between mature sperm from young and old males was investigated by irradiating sperm in inseminated females. A lower sensitivity exists among sperm from young males but not as markedly as when irradiated in the male. A comparison was also made of the oxygen effect in brood patterns after irradiation with conventional x-rays and electrons (betatron). See 1085.

1274 Nair, K.K. PRELIMINARY STUDIES ON THE EFFECTS OF GAMMA-RADIATION ON HOUSEFLY PUPAE WITH SPECIAL REFERENCE TO THE CRITICAL PERIODS IN RELATION TO THE MECHANISM OF EMERGENCE. p. 207-10 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Studies on the radiation sensitivity of housefly pupae in different stages of development have been carried out with special reference to the mechanism of emergence. The different dose levels employed were 500, 1000, 2000, 2500, 5000, and 10 000 r. The data obtained on percentage emergence in each group indicated that the early stages of development were most sensitive to radiation, since a dose of 2000 r and above applied to 30-80-h-old pupae did not appreciably affect the mechanism of emergence in these groups. Development in the 2-5-h-old irradiated pupae was found to be complete, but the flies failed to emerge. The significance of the findings is discussed. (Auth)

1275 Nair, K.K., Rahalkar, G.W. STUDIES ON THE EFFECTS OF GAMMA RADIATION ON THE DIFFERENT DEVELOPMENTAL STAGES OF THE KHAPRA BETTLE, Trogoderma granarium EVERTS. p. 465-77 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963", Vienna, International Atomic Energy Agency. 1963.

The effects of various doses of γ-radiation on different developmental stages were investigated. Females were found to be more susceptible than males. Doses of 6000 rad female pupae as against 16 000 rad for males were required to induce complete sterility. The influence of post-irradiation temperature on radiation damage was investigated. In larvae, the influence was considerable, the LD_{50} (8 d) at 30°C, 34°C and 38°C corresponding to 59 980, 26 360 and 24 100 rad respectively. The stage at which radiation damage manifests itself is largely dependent on the ambient temperature. In irradiated larvae maintained at 30°C, pupation was arrested above 8000 rad; at 34°C and 38°C doses of 10 000 rad and 12 000 rad respectively were required. A reduction of ambient temperature is known to prolong the larval stage, which is reflected by the fact that at low temperature mortality occurred at the larval stage itself, as against the pupal stage at higher temperature.

1276 Nakajima, S., Shimizu, K., Nakajima, K. STUDIES ON THE BIOLOGICAL INFLUENCE OF THE TERMITES EXPOSED TO Co^{60} GAMMA SOURCE. I. INFLUENCES ON THE ADULT OF FORMOSAN TERMITE AND ITS OFFSPRING. Miyazaki Daigaku Nogakubu, Kenkyu, Jiho (Bull. Fac. Agric. Univ. Miyazsaki) 8, 2 (1963) 340-6. (In Japanese, with English summary).

Formosan termites were exposed to Co^{60} γ-source with a dosimetry of 1020 r/h. The following sets were made; irradiated female with irradiated male (female r X male r), non-irradiated female with irradiated male (female X male r) and irradiated female with non-irradiated male (female r X male), and exposures were made, giving dosages of approximately 3000, 6000, 9000 and 12 000 r. The results are summarized as follows: The longevity of the termite was reduced in proportion to the increase of the radiation dosage from 3000 to 12 000 r, but the reduction was not remarkable in the female r X male r and the female X male r exposed to 3000 r. In proportion to the radiation dosage from 3000 r to 12 000 r, the number of the sets depositing eggs as well as the total egg deposits were reduced. The emergence of the soldier caste in the female r X male r decreased with the increase of the radiation dosage same as the above column. In the emergence of soldiers, there were no prominent differences among the radiation dosages, but the number of soldiers were smaller than that of control. The degree of the biological influence of the termites exposed to Co^{60} from 3000 r to 12 000 r is in the following order: female X male r < female r X male < female r X male r. (Auth.)

1277 Oftedal, P. RADIOSENSITIVITY OF Drosophila SPERMATOGONIA. (Abstr.) Hereditas 48, 3 (1962) 543.

Brief note describing investigation aimed at establishing the dose-effect relationship for Drosophila spermatogonia in the range of 0-165 r. Embryos about 18 h old were irradiated with 55 r, 110 r, and 165 r. The results indicate that the initial slope of the dose-effect curve may be quite close to that obtained by Spencer and Stern after irradiation of mature sperm. With increasing dose, the curve flattens out. (From abstr.)

See also p. 19 in "Fourth Report from Norsk Hydro's Institute for Cancer Research for 1961 and 1962". Oslo. Norsk Hydros Institutt for Kreftforskning. 1963.

1278* Olenov, Yu.M., Galkovskaya, K.F., Pushnitsÿna, A.D. MATERIALS FOR DESCRIBING THE EFFECT OF IONIZING RADIATION ON INDIVIDUAL DEVELOPMENT. Tsitologiya 1 (1959) 293-305. (In Russian).

Roentgen exposure of larvae and pupae of Drosophila melanogaster causes the destruction of part of the cells of the imaginal disks, the rudiments of definite organs of the insect. X-ray mutations are the result of the incomplete repair of this injury. Their frequency depends upon the time of repair. The data obtained permit one to give a new interpretation of the concept of the sensitive period in ontogenesis. The stage for which the repair process caused by the inflicted injury coincides with sensitive period for a given indication, for a given external influence. The destruction of part of the undifferentiated cells and the deviations caused by it in the further course of ontogenesis are obviously a general characterization of the effect of ionizing radiation on the developing organism. One should have this picture in mind when working out a theory of the biological action of ionizing radiation. (Auth)

1279* Oster, I.I., Cicak, A.Z. MORTALITY OF IRRADIATED PRE-IMAGINAL STAGES OF Drosophila. Drosophila Inform. Serv. 32 (1958) 143-4.

1280 Palii, V.F., Iirkovskii, G.G. STUDIES ON THE EFFECT OF IONIZING RADIATION ON THE DEVELOPMENT OF INSECTS. Vsesoyuz. Enl. Obshch., Kirgizskoe Otd. Sborn. Ent. Rabot 1 (1962) 70-9. (In Russian).

Musca domestica and Pieris spp. are considered.

1281 Pelerents, C., Brande, Van den, J. INVLOED VAN GAMMASTRALEN OP EITJES VAN Ephestia kuehniella ZELL. (The effect of γ-rays on eggs of Ephestia kuehniella Zell.) Meded. LandbHogesch. Gent 26, 3* (1961) 1401-8. (In Flemish).

In further tests on the effect of γ-rays on eggs of Anagasta (Ephestia) kuehniella (Zell.) eggs 6, 4 and 2 d old were used. Doses of 9000 and 14 000 rad caused significant reductions in the hatching of eggs 6 and 4 d old, respectively; doses of 1000 and 2500 rad stimulated the hatching of eggs 2 d old, and doses of 4000 rad reduced it. A dose of 20 000 rad reduced the hatching of eggs 6 and 4 d old to 24.2 and 0%, respectively, and one of 6000 rad prevented all 2-d-old eggs from hatching. Doses of 1000-2500 rad increased adult emergence from surviving 6-d-old eggs, doses greater than 2500 rad reduced that from 4-d-old eggs, and one of 2000 rad reduced that from 2-d-old eggs. Sterility was increased in the eggs laid by the females, the threshold doses for eggs 6 and 4 d old being 2500 and 2000 rad; adults from eggs treated when 2 d old with 3000 rad or more laid few or no eggs. (RAE-A 51: 1963, 50-1).

1282* Подолян, В.Я. ВЛИЯНИЕ ИЗЛУЧЕНИЯ РАДИОАКТИВНОГО КОБАЛЬТА НА РАЗНЫЕ СТАДИИ РАЗВИТИЯ МУХ. Стр. 210-1 в сб. "Первая зоологическая конференция Белорусской ССР – Тезисы докладов". Минск. 1958.

Podolyan, V.Ya. EFFECT OF RADIOCOBALT IRRADIATION ON THE VARIOUS STAGES OF DEVELOPMENT OF FLIES. p.210-1 in "Papers presented to the First Zoological Conference of the Byelorussian SSR", Minsk, 1958".

1283 Proverbs, M.D., Newton, J.R. INFLUENCE OF GAMMA RADIATION ON THE DEVELOPMENT AND FERTILITY OF THE CODLING MOTH, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). p.65-81 in AFCL-1890, Vol.3, 1964.

See 1284

1284 Proverbs, M.D., Newton, J.R. INFLUENCE OF GAMMA RADIATION ON THE DEVELOPMENT AND FERTILITY OF THE CODLING MOTH, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). Canad. J. Zool. 40, 3 (1962) 401-20.

Exposure of the mature pupa or the newly emerged adult of the codling moth, Carpocapsa pomonella (L.), to 40 000 rads of γ-radiation induced dominant lethality in at least 98% of the sperm without affecting adult emergence, mating behaviour, or adult longevity. Higher dosages decreased the frequency of mating. Irradiation of eggs, mature larvae, or young pupae induced dominant lethality in a high percentage of the sperm, but caused prohibitively high mortality and frequently reduced mating. The female was more radiosensitive than the male. In general, sensitivity decreased as development progressed from the egg to the adult stage (Auth.)

See 1283

1285 Quraishi, M.S., Metin, M. RADIOSENSITIVITY OF VARIOUS STAGES OF Callosobruchus chinensis L. p.479-84 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Insects were reared on moong (Phaseolus munog L.) seeds at a temperature of 29 ± 1°C and a humidity of 70 - 75%. Under these conditions the insect life cycle was 18-22 d. Eggs were irradiated at dose-rates of 80 kr/h at 0.5 cm, and larvae, pupae and adults at 20 kr/h, at 1 cm from a 4-c Ir^{192} source. A dose of 15 kr gave 100% mortality in eggs. A sensitive stage may exist for a short period during the 1st 24 h of egg development. In 8-d-old larvae 100% mortality was obtained with 20 000 rad. The pupae seem to be less radiosensitive than eggs or larvae, and 47 000 rad were required for 100% mortality. Although mating took place after irradiation, the eggs produced when either parent had been irradiated with 42 000 rad did not hatch. Such eggs continued to be produced even when either or both parents had been subjected to 67 000 rad (the highest dose tested).

1286* Rattan Lal, Rahalkar, G.W., Sethi, G.R., Saxena, P.N. STUDIES ON THE EFFECT OF BETA-RADIATIONS ON INSECTS. II. THE EFFECT OF BETA-RADIATIONS (IRRADIATION OF FULL-GROWN CATERPILLARS AND FRESHLY-FORMED PUPAE) ON THE LIFE-HISTORY OF Corcyra cephalonica STAINTON Indian J. Ent. 22, 1 (1960) 15-21.

Beta-radiation was supplied by P^{32} in the form of $H_3P^{32}O_4$. Intensities of 555, 1111, 2222, and 3333 mrep/h for 24 h were used. A dosage of 1111 mrep/h applied to eggs, 1st-instar and full-grown caterpillars, and freshly-formed pupae proved to be the most beneficial and stimulating with regard to the development of progeny up to completion of the 2nd generation. The usefulness of such treatment of preimaginal stages for mass rearing is pointed out. The effects of β-radiation depend on radiation intensity and the developmental stage irradiated. Thus, whereas 3333 mrep/h is to some extent detrimental to full-grown caterpillars and freshly-formed pupae, it does not produce adverse effects on eggs and 1st-instar caterpillars.

1287 Ray, D.T. FECUNDITY STUDIES ON X-RAYED Mormoniella vitripennis. (Abstr.) Genetics 48, 7 (1963) 906.

X-rayed Mormoniella have shown, with few exceptions, a marked reduction in fecundity. This has been measured as the number of offspring per female, and appears greater as radiation dosage increases. Differences in total offspring may result from many variations in fecundity, such as sterility, permanent diapause, or inability to pupate or eclose. Using the "Damp Chamber" technique, eggs were counted and observed from the time of laying until the completion of metamorphosis. Results obtained by use of this technique indicate that reduced egg production shows little, if any, relationship to radiation dosage. Eggs laid by treated females are equal or, in a few cases, greater in number than those of controls. Raying the eggs in various stages of meiotic development produces many lethals which exert their effect primarily during the early embryonic development. Eggs complete their development and are laid but show little inclination to begin or complete cleavage activities. Over 90% show no activity. Another 7% progress only through various cleavage stages, and in the remainder, a cessation of metabolic activity during later stages of metamorphosis occurs. Reduced fecundity appears to be due primarily to the effects of induced lethal genes rather than to a reduction in the number of eggs laid.

1288 Сидорова, В.Р. О ВЛИЯНИИ ГАММА-ЛУЧЕЙ Co^{60} НА МАЛУЮ НАЗЕМНУЮ СОВКУ (Laphygma exigua Hb.). Стр. 154-8 в сб. "Вопросы биологии и краевой медицины", №3. Ташкент. 1962. Р. Ж. Биол. №13Е182. 1963.

Sidorova, V.R. EFFECT OF Co^{60} GAMMA RAYS ON THE SMALL CUTWORM. p.154-8 in "Voprosy biologii i kraevoi meditsiny", No.3. Tashkent, Akad. Nauk Uzb. SSR. 1962. R. Zh. Biol. No. 13E182, 1963.

A preliminary survey was made on the effect of γ-irradiation on the cutworm moth, Laphygma exigua. Irradiation of larvae in the 3rd instar with 10 000 and 50 000 r Co^{60} caused 40% mortality in the 1st 7 d. Higher dosages (100 000 - 250 000) killed 100% of the larvae. No unfavourable effect was found when larvae fed on irradiated cotton leaves (10 000 and 50 000), but there was a reduction in the respiratory rate of these larvae. Irradiated phosphoörganic preparations (10 000 and 50 000 r) in a 0.2% concentration retained their toxic unchanged properties. (BA 45: 1964, 21089)

1289 HISTOLOGISCHE UNTERSUCHUNG ZUM "FRÜHTOD" RÖNTGENBESTRAHLTER Drosophila-EIER. (Histological investigation on the "premature death" of x-irradiated Drosophila eggs.) Naturwissenschaften 48 8 (1961) 310.

A histological study was made of the premature death of Drosophila eggs, 1.5 h old, exposed to doses of x-radiation from 250 to 3000 r. At various times after the irradiation the embryos were fixed by the Huettner method, and the development stage was microscopically determined. The results show that after a dose of 3000 r 75% of the eggs have the histological state of 1.5-h controls. The distribution of the development stages, compared to the development of controls, is tabulated. None of the irradiated eggs attain the development of the controls. (NSA 15: 1961, 20604)

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* Dertiende Internationaal Symposium over Fytofarmacie en Fytiatrie, 9 Mei 1961 (Thirteenth International Symposium on Phytopharmacy and Phytiatry, 9 May, 1961) p.981-1729. Ghent, 1961.

1290 Taege, M. UNTERSUCHUNGEN ÜBER SPERMATOGENESE UND KEIMESENTWICKLUNG NACH BESTRAHLUNG DER MÄNNCHEN VON *Calliphora erythrocephala* MEIG. DIPTERA, CALLIPH. (Investigations on the spermatogenesis and embryonic development following irradiation of *Calliphora erythrocephala* Meig. Diptera, Calliph. males.) *Dtsch. ent. Z.* *10* (1963) 335-77. (In German).

Male adults were given 250-5000 r x-rays 1 d before eclosion; testes were examined for any histological effects. Numerous disturbances in the meiotic and mitotic processes were observed. Judging by the purely physiological damage of spermatogonial tissue (dissolution of nuclei, pycnosis, nuclear vacuoles) there appears to be a particularly radiosensitive stage during the spermatogonial growth phase. No changes were found in sperm motility or fertilizing ability, nor in the vitality of irradiated males. Dominant lethals were induced in male germ cells following sufficiently high doses, deduced from the exponential dose/egg-survival curve obtained for irradiated males mated with non-irradiated females. To determine differences in radiosensitivity during spermiogenesis, irradiated males were mated at intervals with non-irradiated females but this method, successful with *Drosophila*, proved unsuitable for *Calliphora*. A cytological investigation was made of eggs fertilized with irradiated sperm. The majority died at the 8-16 blastomere stage. The morphogenetic function of nuclei in early spermiogenesis of *Calliphora* is discussed.

1291* Takeda, H., Tanaka, T., Asano, K. STUDIES ON THE AFTER-EFFECTS OF X-RAYS ON THE LARVAL DEVELOPMENT AND THE COCOONS DURING THE EMBRYONIC STAGES. *Res. Reps. Fac. Text. Sericult. Shinshu Univ.* *9* (1959) 60-73.

5000 r caused many deformed adults whose wings expanded incompletely. Their incidence apparently increases when the eggs are irradiated in the older embryonic stage. Poor hatching and quite irregular larval growth after the 3rd instar followed irradiation (4000 and 5000 r) of 7-9 d eggs. Some dwarf larvae produced were similar to the precocious larvae resulting from the removal of corpora allata. Cocoon fibre quality deteriorated. Many kinds of abnormal cocoon were produced. The silk layer of the round cocoon was generally loosened. A greater quantity of silk wadding was found in irradiated cocoons than in controls. X-irradiation of the developing embryo evidently damages the functions of various organs related to cocoon formation such as muscles and the nervous system. The fibres of the cocoon and its wadding are remarkably thick and contain a great deal of sericin; the shape of fibroin, in fibre cross-section, is non-uniform in the silk wadding and triangular in the cocoon.

1292 Tobias, C.A. STUDIES ON HEAVILY IONIZING PARTICLES - HILAC STUDIES. (Abstr. AIA1124) p.7 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

The biological effects of heavy particles have been under study in the Lawrence Radiation Laboratory since 1935. The accelerators currently being used are the Heavy Ion Linear Accelerator (HILAC), the 184" Cyclotron, the new 88" Cyclotron and the LPTR at Livermore. The HILAC is the source of heavy ions, including deuterons, alphas, lithium, boron, carbon, nitrogen, neon, and argon. Larvae and pupae of the confused flour beetle, *Tribolium confusum*, are eminently suited for investigations concerning the developmental effect of heavy ion radiations. Preliminary data taken in the current year indicate that strong steady magnetic fields (3500 gauss) can anneal the radiation damage initiated in the pupae by heavy radiation.

1293 Valencia, R.M., Valencia, J.I. STUDIES OF THE GENETIC EFFECTS OF IRRADIATION DURING THE PERIFERTILIZATION STAGES OF *Drosophila melanogaster*. p.179-84 in "4th Inter-American Symposium on the Peaceful Application of Nuclear Energy - Mexico City, 9-13 April 1962". Washington, D.C., Pan American Union. 1962.

Stage 14 oöcytes, recently fertilized eggs and early embryos were found to be about equally sensitive to an x-ray dose of 500 r. All gave about 60% embryonic mortality. Mature sperm, on the other hand, irradiated with the same dose, conferred a relatively low (10%) mortality upon the eggs fertilized by it. This difference suggests that the major cause of death in irradiated eggs is not chromosome breakage. The damage must, nevertheless, be nuclear. It is proposed that a key biochemical entity, closely associated with the genetic material, could be the target. The lack of difference in mortality among the three egg stages probably indicates that 500 r is a saturating dose for the event concerned in the death of these cells. (Auth).

1294 Würgler, F.E. EXPERIMENTAL ANALYSIS OF A LINEAR DOSE EFFECT CURVE RESULTING FROM X-IRRADIATION OF *Drosophila* EGGS. (Abstr.) p.199 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

In earlier experiments, Ulrich (1954) found a dose-effect curve of the form $y = 1 - \exp(-kD)$ for the embryonic mortality of 15±5-min-old *Drosophila* eggs after a 3-min exposure to x-rays. Improvements in the egg-collecting procedure enabled us to shorten the collecting period to 3 min and thus to reduce the age variability of the egg samples to ±1.5 min. With this short collecting time one obtains an ample number of eggs homogeneous in division stage as shown by cytological studies. Thus, it becomes possible to get four dose effect curves (exposure 5 sec) with egg age variation of 10 - 13; 13 - 16; 16 - 19; 19 - 22 min. The four curves are very different in shape as well as in slope, but the summation of all four leads to a straight line. The steepness of the summation curve is (within the experimental limits) the same as was found in a control experiment irradiating 10-22-min-old eggs. Consequently, it was possible to show that in this particular case the linear dose effect curve cannot be interpreted as a "one-hit-curve".

1295 Würgler, F.E. THE RADIOSENSITIVITY OF EARLY DEVELOPMENTAL STAGES OF *Drosophila*. (Abstr.) *Int. J. Rad. Biol.* *6*, 4 (1963) 378-9.

Egg samples of different mean ages (10·5±1·5; 11.5±1·5 min, etc.) were subjected to a fixed dose (exposure 5 sec) and the rate of embryonic mortality scored. The rate of killed embryos varies with the age of the eggs at the moment of irradiation. It seems that this fluctuation of mortality-rate is the expression of different radiosensitivities of different division stages. In his earlier experiments with 15±5 min (exposure 3 min) old eggs Ulrich found a linear dose-effect curve. The same curve shape was found in a similar experiment irradiating 16±6 min (exposure 5 sec) old eggs. With the technique of the 3-min samples it became possible to subdivide the latter arrangement and to get 4 dose action curves with an egg-age variation of 11·5±1·5; 14·5±1·5; 17·5±1·5, and 20·5±1·5 min, a summarization of which would be expected to lead to the linear curve found for the 16±6 min samples. The 4 curves are very different in shape as well as in slope and the sum curve is a straight line with a slope which is - within experimental limits - the same as found for the 16±6 min curve. Consequently, it was possible to show that in this particular case the linear dose-effect curve cannot be interpreted as a "one-hit-curve". (From abstr.)

1296 Ytterborn, K.H. X-RAY SENSITIVITY OF SPERMATOGONIA AND SPERMATOZOA IN *Drosophila melanogaster*. *Nature*, Lond. *194* (1962) 797-8.

Experiments were conducted to determine if, after irradiation of young spermatogonia, other mutations behave in a manner similar to the induced crossing-over work of Sävhagen. A chromosome free from lethals was isolated and x-ray doses of 900 r used. Spermatogonia were irradiated in larvae, and after eclosion the males were mated in two periods for lethal tests. Spermatozoa in adult males were also irradiated for comparison. The rate of chromosomes with lethals is ~3 times higher for spermatozoa than for spermatogonia after irradiation. A higher rate of independently induced lethals and a lower rate of clusters were found in the mating period 0 to 3 d than in the period 15 to 18 d after eclosion, while there is no significant difference in the rates of chromosomes with lethals; the results agree well with those of Sävhagen. Possible explanations of the results are discussed. (NSA 16: 1962, 20197)

See also:

748 Mutagenic effect of x-rays on moths. (Kortschak, 1962)
768 A comparison of the susceptibility of the grain weevil (*Sitophilus granarius* L.) to accelerated electrons and ^{60}Co gamma radiation. (Bull *et al.*, 1961)
771 Developmental-genetic study of the effect of x-ray irradiation in *Drosophila virilis* and *Bufo valliceps*. (Clayton, 1961)
772 The susceptibility of the rust-red flour beetle, *Tribolium castaneum* (Herbst.) to gamma radiation. (Crook, 1962)
773 The use of ionizing radiation in the preservation of cereal products. (Dal Monte, 1959)
778 Effects of irradiating single and mixed species of beetles. (Erdmann, 1961)
779 X-ray tolerance of two related species of beetles. (Erdman, 1962)
782 The effect of ionizing radiation on the biology and ecology of *Rhodnius prolixus*, the principal vector of *Schizotrypanum* (i.e. *Trypanosoma*) cruzi in Venezuela.
790 Influence de l'irradiation sur les adultes de *Sitophilus sasakii* Takahashi (Curculionidae) et leurs descendants. (Laviolette and Nardon, 1963)
791 Action des rayons γ du cobalt-60 sur la mortalité et la fertilité des adultes d'un charaçon du riz. (Laviolette and Nardon, 1963)

797 X-irradiation of the developing male germ cells of Tribolium confusum. (McDonald, 1961)

801 Genetic sensitivity and differential killing in irradiated Drosophila spermatogonia. (Oftedal, 1963)

804 Quelques résultats supplémentaires concernant l'influence des rayons gamma sur les chrysalides et les oeufs de la teigne de la farine "Ephestia kuehniella Z." (Pelerents, 1963)

806 La protection des denrées contre les insectes ravageurs par l'emploi des radiations ionisantes en vue d'obtenir la stérilité des insectes adultes. Étude particulière de la réaction des gonades de "Sitophilus granarius". (Pesson and Vernier, 1963)

809 Sterilization of the codling moth by gamma-irradiation. (Proverbs, 1962)

810 Action des rayons γ sur la stérilité d'une noctuelle du coton (genre Laphygma exigua). (Rasulov, 1963)

811 Effect of gamma radiation on the reproductive potential of the Mexican fruit fly. (Rhode et al., 1961)

815 Sterilization of Dacus oleae by gamma radiation. (Thomou, 1963)

816 X-ray induced "dominant lethals" in inseminated eggs of Drosophila. (a) Experiments in the stage between completion of meiosis and beginning of cleavage. (Ulrich, 1963)

884 Similarity of x-ray-induced mutation rate in gonia of Drosophila females and males. (Meyer and Muller, 1961)

892 A study of sex predetermination in the mealy bug Planococcus citri (Risso). (Nelson-Rees, 1960)

900 The cell lineage of the sternopleura in Drosophila melanogaster. (Stern, 1963)

901 Radiation and mutation rate. (Stern, 1963)

910 The mutation rate at specific autosomal loci in different species of Drosophila. (Turku, Finland, n.d.)

917 The effect of x-irradiation on somatic crossing-over in Drosophila melanogaster. (Abbadessa and Burdick, 1963)

968 The genetic basis of somatic damage produced by radiation in third instar larvae of Drosophila melanogaster. (Ostertag, 1961)

973 Effects of x-rays on salivary-gland chromosomes during early stages of development. (Sengün, 1958)

980 The effect of maternal age and radiation on the rate of non-disjunction in Drosophila melanogaster. (Uchida, 1962)

982 Increased recombination from female Drosophila irradiated as larvae without oöcytes. (Whittinghill and Davis, 1961)

983 Unchanged recovery of cross-overs after x-irradiation of pupal Habrobracon. (Whittinghill and Allen, 1961)

1002 Effects of x-ray irradiation in Drosophila virilis at different stages of spermatogenesis. (Clayton, 1961)

1009 Methods for estimating differential radiosensitivity. (Oster and Pooley, 1963)

1013 A cytogenetic study of the effects of x-irradiation on Aedes aegypti. (Rai, 1963)

1019 Cell stages and differential sensitivity to irradiation in males of Drosophila melanogaster. (Sävhagen, 1963)

1030 Variation of radiosensitivity during meiosis and early cleavage in newly laid eggs of Drosophila melanogaster. (Würgler et al., 1963)

1043 Modification effects with magnetic fields. (Amer, 1963)

1049 The effects of nitric oxide on radiation damage in Drosophila virilis and Drosophila melanogaster. (Capps, 1961)

1055 Some effects of oxygen on the insect Anagasta kühniella and Tenebrio molitor. (Clark and Cristofalo, 1961)

1075 Ultrafractionation and biological efficiency of fast electrons. Investigations on "eggs" of Drosophila melanogaster of different stages of development. (Künkel and Oberheuser, 1962)

1078 The action of 14-MeV electrons, 14-MVp and 200-KVp x-rays and the influence of the energy spectrum of 14-MeV electrons on eggs of Drosophila. (Markus and Sticinsky, 1962)

1079 The effect of the energy spectrum from 14 MeV electrons, and the relative effects of 14 MeV electrons, and of 14 MV and 200 kV x-rays on Drosophila eggs. (Markus and Sticinsky, 1963)

1082 Tolerance of gonial cells of Drosophila melanogaster for heavy x-ray doses divided into installments. (Meyer et al., 1959)

1090 The influence of radiation in altering the incidence of mutations in Drosophila. (Muller, 1963)

1095 Ultrafractionation and relative biological effectiveness of fast electrons. Experiments on Drosophila embryos at different stages of development. (Oberheuser and Künkel, 1963)

1106 Effect of a low temperature on the development of radiation injury in eggs of the silkworm Bombyx mori L. (Paulov, 1961)

1118 The relative biological effect of P^{32} β radiation. I. Comparison of P^{32} β radiation and x-rays as to their biological effects on Drosophila melanogaster. (Rudnicki, 1961)

1122 The effect of oxygen concentration on the frequency of induced XO males and non-disjunction females after irradiation of Drosophila males. (Sävhagen, 1961)

1143 Two types of dose-rate dependence on radiation-induced mutation rates in spermatogonia and oögonia of the silkworm. (Tazima, et al., 1961)

1147 Further studies on dose-rate dependence of radiation-induced mutation rates in spermatogonia and oögonia of the silkworm. (Tazima and Kondo, 1962)

1148 Studies on the genetic effect of radiation 1959-1960. II. Studies on the genetic effect of radiation with silkworm. (2) Two types of dose-rate dependence of radiation-induced mutation rate in spermatogonia and oogonia of the silkworm. (Tazima et al., 1962)

1149 Further studies on two types of dose-rate dependence of radiation-induced mutation rates in spermatogonia and oogonia of the silkworm. (Tazima and Kondo, 1962)

1151 A study of dose-dependence of radiation-induced mutation rates in Drosophila melanogaster, allowing for the degree of maturity of the germ cells. (Traut, 1962)

1154 The relationship between dosage and mutation rate in x-radiation of Drosophila zygotes. (Ulrich, 1960)

1155 Oxygen effect in newly laid Drosophila eggs. (Ulrich and Würgler, 1962)

1156 Partial irradiation of Drosophila zygotes by X-rays. (Ulrich, 1963)

1210 Genotype X environment interaction with isogenic lines of Drosophila melanogaster. (Kidwell, 1963)

1298 Effects of x-irradiation upon cell population and morphogenesis in the developing beetle wing. (Beck and Hayes, 1962)

1299 Effects of x-irradiation upon cell population and morphogenesis in the developing beetle wing. (Beck and Hayes, 1962)

1300 Cell differentiation and radiopathology in the wing of Tribolium confusum. (Beck, 1962)

1301 Effects of x-irradiation upon cell population and morphogenesis in the wing of Tribolium confusum. (Beck, 1962)

1302 Effect of x-irradiation on cell differentiation and morphogenesis in a developing beetle wing. (Beck, 1963)

1303 Temperature dependence of wing abnormality in Tribolium confusum. (Slater et al., 1963)

1314 Répercussion de l'influence des rayons γ dans la descendance de Sitophilus sasakii Takahashi (Coléopt. Curcul.). (Nardon, 1962)

1316 Effects of x-rays on meal worm embryos. (Po-Chedley, 1963)

1317 The effects of x-irradiation on the free A-amino nitrogen fraction of the meal worm, Tenebrio molitor, ova. (Po-Chedley, 1963)

1324 Some effects of x-irradiation on longevity in Habrobracon females. (Clark, 1961)

1325 The modification by x-irradiation of the life span of haploids and diploids of the wasp, Habrobracon sp. (Clark and Rubin, 1961)

1326 Life span differences between haploid and diploid males of Habrobracon serinopae after exposure as adults to x-rays.

1327 The effect of gamma radiation on the viability and fertility of Lucilia sericata Mg. (Dipt.) irradiated as pupae. (Donnelly, 1960)

1337 The effect of x-radiation on longevity, emergence, and DDT-susceptibility of the house fly. (Varzandeh and Moos, 1963)

1341 Response of Tribolium larvae to x-irradiation. (Ducoff and Walburg, 1960)

1343 Effects of gamma radiation on Culex fatigans egg rafts. (Ghosh et al., 1961)

1344 Lethal effects of X-rays on the housefly, Musca domestica L. (Grasso et al., 1962)

1345 Lethal effects of X-rays on Musca domestica L. (Grasso et al., 1963)

1347 Preliminary studies on irradiation of some common stored-grain insects in Pakistan. (Huque, 1963)

1353-a The genetic basis of somatic damage produced by radiation in third instar larvae of Drosophila melanogaster. I. Death before maturity. (Ostertag, 1963)

1354 Some early effects of ionizing radiation on the German cockroach, Blattella germanica. (Ross and Cochran, 1963)

1356 Effects of gamma radiation on three species of Philippine insect pests. (Viado and Manoto, 1963)

1359 Biological effectiveness of 30-MeV electrons in dependence on the tissue depth and in comparison with 180-keV and 31-MeV photons. I. Lethality test on one-hour Drosophila embryos. (Fritz-Niggli and Schinz, 1961)

1360 Biological effectiveness of 30-MeV electrons depending on tissue depth and in comparison with 180-keV and 31-MeV photons. II. Lethality tests on four-hour old Drosophila embryos. (Fritz-Niggli and Schinz, 1962)

1362 Determination of the RBE of 14-MeV neutrons using 14-day-old grasshopper embryos (Chortophaga viridifasciata and Encoptolophus sordidus). (Hansen, 1963)

1363 The effects of continuous and fractionated doses of gamma-radiation on the survival and fertility of Sitophilus granarius (Calandra granaria L.). (Jefferies, 1962)

1364 The effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (Calandra granaria) L. (Jefferies and Banham, 1961)

1366 Radiosensitivity of the Drosophila embryo. (Johansen et al., 1963).

1368 Modification of radiation response during embryonic development by the use of elevated temperature. (Slater et al., 1962)

1369 Oxygen dependence of the lethal and mutation rates induced by x-irradiation of Drosophila zygotes. (Würgler, 1960)

1370 Modification of x-ray induced embryonic mortality by different anoxia conditions before and during irradiation of uncleaved Drosophila melanogaster eggs. (Würgler, 1961)

1371 Resistance of Sitophilus granarius and Sitophilus oryza at different stages of their development to γ-irradiation from cobalt-60. (Bruel and Bollaerts, 1960)

1372 X-ray effects on single and mixed species populations of Tribolium confusum and Tribolium castaneum (Coleoptera: Tenebrionida.) (Erdman, 1962)

1375 The importance of competitiveness of radiosterilized males in mosquito-control programs. (Dame and Schmidt, 1962)

1382 The effects of gamma radiation on the biology and behaviour of forest insects and the possibility of their control by means of irradiation techniques. (Stark, 1963)

1407 Developmental homeostasis in x-rayed populations of Drosophila pseudo-obscura. (Tantawy, 1963)

1414 Effects of radiation on ecological systems. (Erdman, 1963)

1415 Ecological effects of ionizing radiation on organisms, communities and ecosystems. (Platt, 1963)

1455 Sterilization of the Mediterranean fruit fly and its application to fly eradication. (Katiyar and Valerio, 1963)

1456 The application of nuclear energy to agriculture. (Moh, 1963)

1464 Could this be death to the codling moth? (Proverbs and Newton, 1961)

1465 Effect of gamma rays on insects. Progress on the use of induced sexual sterility for the control of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs, 1961)

1466 Control of the codling moth, Carpocapsa pomonella (L.) by the release of sexually sterile males. (Proverbs, 1963)

1473 Irradiation. A sterilization weapon against the corn borer. (Springell, 1963)

1481 Disinfestation of dried figs by gamma radiation. (Papadopoulou, 1963)

1486 Effect of gamma radiation on some wood-boring insects. (Bletchly, 1961)

1493 Irradiation of fruits and vegetables in a mobile cobalt-60 unit. (Harvey, 1963)

1498 Some experimental data on cobalt-60 radiation doses capable of arresting insect infestation of cereals and flour. (Pesson, 1963)

1499 Utilisation des radiations ionisantes (^{60}Co) pour la protection des denrées contre les insectes nuisibles. Recherches relatives à la détermination des doses utiles pour assurer la stérilité des insectes. (Pesson, 1963)

1512 Study on the development of parasites Coleophora laricella Hbn. by means of x-ray photography. (Eidmann, 1962)

I-B-2 MALFORMATIONS

1297 Annan, M.E., Reitan, P.J. EFFECTS OF DESICCATION OF Drosophila FEMALES ON THE FREQUENCIES OF IRRADIATION INDUCED EMBRYONIC ABNORMALITIES. (Abstr.) Genetics 46, 8 (1961) 848.

Virgin D. melanogaster females were desiccated immediately prior to exposure to 4000 r units of γ-irradiation from a Co^{60}-source. The effects of this treatment were observed on egg hatchability. The results confirm the findings of Herskowitz in that desiccation enhances the irradiation-induced reduction in egg hatchability. In addition, observations were made on late stage embryos (16 or more hours of development) in order to determine whether or not the desiccation effects could have been due to effects on fertilization. The embryos were classified as either (1) normal, (2) grossly abnormal, or (3) showing no development. Preliminary results indicate that there is no difference in the developmental picture between embryos from irradiated flies whether they were desiccated or not. Further observations are being made to substantiate these results and to determine whether or not more subtle embryonic abnormalities might be contributing to the desiccation effects on irradiation-induced "dominant lethals."

1298 Beck, J.S., Hayes, T.L. EFFECTS OF X-IRRADIATION UPON CELL POPULATION AND MORPHOGENESIS IN THE DEVELOPING BEETLE WING. (Abstr. E4) Rad. Res. 16 (1962) 573.

See 1299.

1299 Beck, J.S., Hayes, T.L. EFFECTS OF X-IRRADIATION UPON CELL POPULATION AND MORPHOGENESIS IN THE DEVELOPING BEETLE WING. (Abstr.) P. 61 in "Biology and Medicine. Semiannual Report, Spring 1962". UCRL-10211, California. Univ., Berkeley, Lawrence Radiation Lab. June 1962.

Recent studies have disclosed the dose-incidence relation, the time course of radiosensitivity and the location of the sensitive site for the wing deformity in Tribolium confusum. The membranous wing consists of a flat, closed envelope of cuticle around a double layer of cells of a single type that form the cuticle with its spines. The total mass of the deformed and normal wings are equal within limits of error. To determine their relative total C content, wings were exposed to 900 MeV α-particles, producing the $C^{12}(\alpha, \alpha n)C^{11}$ reaction. The positron-emitting C^{11} was then counted. No significant difference was found. The total P content was explored by the thermal neutron reaction, $P^{31}(n, \gamma)P^{32}$. Individual wings were compared (measuring down to 0.03 μg P). The deformed wing contained 2.3 ± 0.7 times as much P. By quantitatively removing the imaginal wing from the pupal cuticle, the P content at various stages of development was determined. A general increase in density to electrons and in osmiophilic foci were found by electron microscopy, and also a 50% decrease in the number of spines in the maldeveloped wing. Studies are under way to prove the hypothesis of a 1:1 correspondence between cells and spines, thus furnishing a permanent record of cell population and morphogenetic activity. (From abstr.)

1300 Beck, J.S. CELL DIFFERENTIATION AND RADIOPATHOLOGY IN THE WING OF Tribolium confusum. p. 122-59 in "Biology and Medicine. Semi-annual Report, Spring 1962". UCRL-10211, California. Univ., Berkeley. Lawrence Radiation Lab. June 1962.

Data are presented from studies on cell differentiation and pathological effects observed in the wing of the flour beetle, T. confusum, after exposure of larvae, pupae, and adults to various doses of x-radiation. Observations were correlated on microscopic transverse sections and whole wing preparations. The only consistently apparent deformities elicited by x-irradiation were deformities of membranous wings and the elytra. This response was found to be reproducible and proportional to dosage. The characterizing nature of the deformity was investigated in neutron-activated and control wings. The deformed wings showed 1.7 times as much phosphorus as control wings and 1.3 times as much carbon as control wings. Morphological differences in the developing wings were observed by both light and electron microscopy. Morphogenesis of the wing was shown to be quite radiosensitive at certain critical times. Radio-induced aberrations in timing and development are described. 143 references. (From NSA 16: 1962, 32653)

1301 Beck, J.S. EFFECTS OF X-IRRADIATION UPON CELL POPULATION AND MORPHOGENESIS IN THE WING OF Tribolium confusum. (Abstr.) p. 226 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The membranous wing of the confused flour beetle develops almost entirely by the activity of a single type of cell which forms a highly refined, uniform structure, consisting of a multi-layered cuticle with regularly spaced projections (spines). Cell differentiation and cuticle and spine formation occur for the most part in the first 3 d of the 7-d pupal period. X-irradiation of the pupa on the 1st day of pupal life causes a specific deformity of the wing, which becomes apparent upon eclosion. The induction of this deformity begins at 1000 r and occurs in over 95% of animals at 2200 r. The radiosensitive period ends sharply at 30 h after pupation. Spatially, the radiosensitive region is in the body anterior to the wing, as shown by collimated x-ray beams and microbeams of heavy ions. The nature of this deformity, which grossly appears as a warping and failure of folding, has been explored with light microscopy, electron microscopy, and activation analysis. The remarkable thinness of the wing (0.5μ or less) makes rapid scanning and precise orientation possible with the electron microscope. Such studies have revealed ultramicroscopic lesions, an overall thickening, and a relative paucity of spines in the affected wings (and there is some evidence for a one-to-one correspondence between cells and spines). By the $C^{12}(\alpha, \alpha n)C^{11}$ reaction, no difference in carbon content was found. However, activation of phosphorus by thermal neutrons $P^{31}(n, \gamma)P^{32}$ revealed a striking increase (more than doubled) of phosphorus in the affected wings. This divergence of phosphorus content has been traced during the course of development. (From abstr.)

1302 Beck, J.S. EFFECT OF X-IRRADIATION ON CELL DIFFERENTIATION AND MORPHOGENESIS IN A DEVELOPING BEETLE WING. Rad. Res. 19 (1963) 569-81.

The membranous wings of the confused flour beetle, Tribolium confusum, are subject to an apparently specific gross deformity induced by x-irradiation of 1000 to 2000 r during the first 37 h of the 6-d pupal stage. The incidence of wing deformity as a function of dose was determined, the survival curve showing a shoulder to about 1000 r (semi-log plot) and a D_0 of 110 r (where D is the number of deformed pupae, following exposure). The radiation damage was manifest microscopically and chemically as a morphological transformation of some of the hypodermal cells in the wing; disorder of the spine array in regions; malformation, absence, and iteration of spines; delays in some developmental event; and disruption of the normal loss of cellular material from the wing. The amount of phosphorus in control and experimental wings was determined by measuring the P^{32}-radioactivity in following neutron activation, and gave 0.03 μg and 0.08 μg of P/wing respectively at 1 d after eclosion, i.e. phosphorus-retention by the radiation-damaged wing.

1303 Slater, J.V., Rescigno, A., Amer, N.M., Tobias, C.A. TEMPERATURE DEPENDENCE OF WING ABNORMALITY IN Tribolium confusum. Science 140 (1963) 408-9.

When T. confusum pupae were exposed continuously to temperatures from 10°C to 40°C, the adults which finally emerged exhibited wing abnomralities typical of those obtained with x-irradiation. The data indicate the implication of two processes. Two mathematical models are suggested to account for this phenomenon. (Auth.)

See also:

208 Neutron activation analysis for phosphorus in a study of development in a beetle wing. (Beck and Manney, 1962)
472 The genetic and developmental effects of ingested radioactives in Habrobracon. (Grosch, 1960)
789 Preliminary experiments on the sterilization of the pupae of the Khapra beetle by irradiation with gamma rays. (Kansu, 1962)
804 Quelques résultats supplémentaires concernant l'influence des rayons gamma sur les chrysalides et les oeufs de la teigne de la farine "Ephestia kuehniella Z." (Pelerents, 1963)
854 The action of radiation and other mutagenic agents (1) in inducing mutation in Drosophila females, and (2) in controlling the action of specific genes responsible for suppressing uncontrolled growth. (Glass, 1961)
957 The preliminary investigation of salivary gland chromosomes of Chironomus tentans Fabr. from the Clinch river. (Nelson and Blaylock, 1963)
1047 Influence of penicillin on frequency of induced mutation. (Burdette, 1961)
1158 A study of the successive effect of roentgen rays and temperature upon the frequency of mutations and roentgenomorphoses. (Vatti, 1963)
1234 Effects of radiation upon development of Tribolium confusum. (Beck, 1961)
1237 Control of the Mediterranean flour moth Anagasta kühniella Zell by sterile male release. II. Susceptibility to gamma radiation. (Bull and Wond, 1963)
1238 Some effect of gamma radiation on the biology and morphology of the Khapra beetle, Trogoderma granarium Everts. (Carney, 1962)
1244 Arrested development in x-rayed larvae of Ephestia kuehniella Zeller (Lepidoptera: Phycitinae). (Erdman, 1961)
1266 A study of the embryology of the cockroach, Blaberus craniifer Burmeister. (Larsen, 1963)
1267 The effects of x-irradiation on the embryos of invertebrate animals. (Larsen, 1962)
1268 Some effects of x-irradiation on embryos of the cockroach Blaberus craniifer. (Larsen, 1963)
1291 Studies on the after-effects of x-rays on the larval development and the cocoons during the embryonic stages. (Takeda et al., 1959)
1353-a The genetic basis of somatic damage produced by radiation in third instar larvae of Drosophila melanogaster. I. Death before maturity. (Ostertag, 1963)
1356 Effects of gamma radiation on three species of Philippine insect pests. (Viado and Manoto, 1963)
1357 Synergistic action of x-irradiation and elevated temperatures on development. (Amer and Slater, 1961)
1358 Analysis of the combined influence of x-irradiation and elevated temperatures on development. (Amer et al., 1962)
1367 Comparative influence of accelerated heavy nuclei on anomalous development in Tribolium. (Slater et al., 1961)
1368 Modification of radiation response during embryonic development by the use of elevated temperatures. (Slater et al., 1962)
1473 Irradiation. A sterilization weapon against the corn borer. (Springell, 1963)

I-B-3 TISSUE, ORGAN

I-B-3-a RETINA

1304 Baldwin, W.F., Sutherland, J.B., Habowsky, J.E.J. EFFECTS OF X-RAYS ON ELECTRICAL ACTIVITY IN THE EYE OF THE COCKROACH Blaberus giganteus. Nature, Lond. 199 (1963) 616.

Preliminary studies are discussed on the effects of x-rays on both the electroretinograms and the spontaneous electrical discharges in the eye of the cockroach, B. giganteus. Details of the manipulative and irradiative techniques are given, when 2000 r/min were administered. Large doses of radiation were observed to have a marked effect in reducing the amplitude and frequency of the electrical activity recorded from the cockroach eye. B. giganteus reacted to changes in light intensity in the typical "on-off" response of certain insects. An effect on the "on" response was observed. Recovery occurred in both cases, but at different rates.

1305 Демирчоглян, Г.Г., Аллахвердян, М.А., Мелик-Мусьян, А.Б., Оганджанян, В.Г., Погосян, Р.И., Лалаян, А.А., Василян, В.В. О РЕЗУЛЬТАТАХ ИССЛЕДОВАНИЙ ПО ВОЗДЕЙСТВИЮ ИОНИЗИРУЮЩЕЙ РАДИАЦИИ НА СЕТЧАТКУ ГЛАЗА И НЕКОТОРЫЕ СВЕТОЧУВСТВИТЕЛЬНЫЕ СИСТЕМЫ. Радиобиология 2, 3 (1962) 442-9.

Demirchoglyan, G.G., Allakhverdyan, M.A., Melik-Mus'yan, A.B., Ogandzhanyan, V.G., Pogosyan, R.I., Lalayan, A.A., Vasilyan, V.V. RESULTS OF A STUDY ON THE EFFECT OF IONIZING RADIATION ON THE RETINA OF THE EYE AND ON CERTAIN LIGHT-SENSITIVE SYSTEMS. Radiobiologiya 2, 3 (1962) 442-9.

The reactions of the nervous system were studied by examining the effect of various kinds of ionizing radiation on the retina, considered as a special, peripheral part of the central nervous system. The methods used included electroretinography or the recording of electrical potentials of the retina by means of contact-lens electrodes, microelectrode techniques, amperometric determination of the hydrosulfide groups in the retina, and the determination of the absorption spectrum of the visual purple rhodapsin together with histochemical analysis. Moths were used for the study, exposing the test insects to radiations of 1, 5, 10, and 15 kr and using butterflies from unirradiated cocoons as controls. Results agree well with the previously established high radiation sensitivity of the retina, and indicate the importance of protecting it against exposure to ionizing radiation.

1306 Smith, J.C., Kimeldorf, D.J. THE BIOELECTRICAL RESPONSE OF THE INSECT EYE TO BETA RADIATION. USNRDL-TR-698, 29 Nov. 1963. 30 p.

Moths of the family Noctuidae were used to determine the bioelectric responses of the compound eye to ionizing radiation. It was found that β-radiation can induce a bioelectric reaction in the compound eye of the insect. The electroretinographic pattern is indistinguishable from that produced in response to a light stimulus. The flickerfusion frequency threshold is also similar for the two stimuli. However, a difference exists between light and β-radiation in the time course of the dark adaptation process. It could be demonstrated that the disparity is dependent upon the interaction of visual pigment with the light stimulus. An electroretinogram response was elicited by a β dose of less than one milliroentgen at the radiation dose rate of 20 mr/sec. (Auth.)

I-B-3-b REPRODUCTIVE TISSUE

1307 Erdman, H.E. ANALYSES OF THE DIFFERENTIAL RADIOSENSITIVITY OF DEVELOPING REPRODUCTIVE TISSUES IN Habrobracon juglandis (ASHMEAD) TO IONIZING RADIATION. Int. J. Rad. Biol. 3, 2 (1961) 183-204.

Significant developmental stages throughout the life-cycle of the holometabolous and ectoparasitic insect, H. juglandis (Ashmead) were x-rayed with 300 r increments until sterility was illustrated by adult performance. Because of parthenogenetic male production, attention was focused on females. Cytological examination of ovarioles from adults x-rayed at the different stages gave rise to three conclusions concerning the radiopathology of the reproductive system: (1) regardless of dose; somatic tissues functioned normally to produce 4 ovariole sheaths; (2) radiation of larvae adversely affected the trophocytes rather than the oöcyte itself, apparently the damage is chromosomal; (3) radiation of pupae interfered with egg-nurse syncytia differentiation from oögonia. (Auth.)

I-B-3-c HEART, MALPIGHIAN TUBULES, HINDGUT.

1308 Larsen, W. SURVIVAL OF ISOLATED INSECT TISSUES FOLLOWING RADIATION. Ann. ent. Soc. Amer. 56, 5 (1963) 720-1.

Various tissues were excised, irradiated and their survival and the continuation of normal movement tested. Heart fragments from 40-d old embryos were obtained from gravid females of the cockroach Blaberus craniifer Burmeister. A series of 24 hearts were given from 1000 r to 12 000 r x-rays. All except 6 which succumbed to bacterial infection, continued to live and contract for 150 d after treatment. Whole embryos and adults have a lethal point of about 7000 r. Another series of 22 hearts, 11 clusters of Malpighian tubules, and 11 portions of hindgut were treated with Co^{60} dosages up to 93 000 rads. The tubules continued to pulsate for 15 d, hearts to beat for 23 d, and hindguts to carry on gross movements for 60 d after maximum treatments. This extreme resistance to γ-radiation may be due to the very low O_2-requirements of these tissues.

I-B-3-d ABDOMEN (SEGMENTS)

1309 Lee, W.R. PARTIAL-BODY RADIATIONS OF QUEEN HONEY BEES. TID-20299, New Hampshire, Univ., Durham. 1963. 7p.

By shielding abdominal segments III through V queen honey bees survived otherwise lethal doses of x-radiation. In contrast, irradiating only segments III through V with 10 000 r killed all queens within 3 weeks, as did whole-body irradiations. Lead shields that protect segments III through V and permit irradiating either the spermatozoa in the spermatheca or the oögonia of the ovary with higher doses than could otherwise be administered are described. (Auth.)

See also:

806 La protection des denrées contre les insectes ravageurs par l'emploi des radiations ionisantes en vue d'obtenir la stérilité des insectes adultes. Etude particulière de la réaction des gonades de "Sitophilus granarius". (Pesson and Vernier, 1963)
879 Radiation induced viability mutations in the honey bee. (Lee, 1962)
880 Radiation induced viability mutations in the honey bee. (Lee, 1962, 1963)
1012 Radiosensitivity of the mitotic cycle of Aedes aegypti. (Rai, 1962)
1015 Histological studies of radiation sensitivity of spermatogenic cells of the silkworm (Preliminary note). (Sado, 1958)
1169 The effects of gamma radiation and apholate on the reproductive tissues of Drosophila melanogaster Meigen. (Cantwell and Henneberry, 1963)
1172 Some effects of gamma radiation and apholate on the reproductive tissue of Drosophila melanogaster. (Henneberry and Cantwell, 1962)
1184 Histochemical and ultrastructural modifications in the mesenteron of Dacus oleae Gmel. induced by ionizing radiations. (Baccetti et al., 1961)
1185 The effects of gamma radiation on the ovaries of Dacus oleae Gmel. (Baccetti and De Dominicis, 1963)
1187 Cytological interpretations of five types of induced modification in the oviposition-pattern of the wasp Habrobracon. (Grosch, 1963)
1218 Genetic studies of Drosophila strain differences in sensitivity of the testis to the mutagenic action of x-rays. (Ward et al., 1962)
1248 Beginning of reproduction determined by age of the female flour beetle, Tribolium confusum (Coleoptera: Tenebrionidae). (Erdman, 1962)
1249 Beginning of reproduction determined by age of the female flour beetle, Tribolium confusum (Coleoptera: Tenebrionidae). (Erdman, 1962)
1265 Oogenesis and radiosensitivity in Cochliomyia hominivorax (Diptera: Calliphoridae). (LaChance and Bruns, 1963)
1290 Investigations on the spermatogenesis and embryonic development following irradiation of Calliphora erythrocephala Meig., Diptera, Calliph., males. (Taege, 1963)
1361 Nitrogen protection of fecundity and fertility in female Habrobracon treated with x-rays. (Grosch and Clark, 1961).

I-B-4 BIOCHEMISTRY, PHYSIOLOGY, PATHOGEN, PARASITE, AND PESTICIDE SUSCEPTIBILITY

1310 Bartlett, A.C. CHANGES IN QUANTITATIVE TRAITS UNDER SELECTION AND IRRADIATION. Diss. Abstr. 23, 10 (1963) 3595-6.

Selected lines from a highly heterozygous population of Tribolium castaneum had a high average body weight, up to a certain point beyond which continued selection had no further effect. Fitness was severely affected in the large lines and effects of irradiation on fitness were studied. Strain response (original foundation strain and large strains) of body weight to high selection and random selection along with response to 0, 100 r and 1000 r of radiation were tested. In both, high selection was still the most efficient way of changing body weight. Irradiation lowered the reproductive potential (progeny number per mating); in combination with high selection irradiation had a detrimental effect on the response. Even though irradiation has been used successfully to produce response to selection in other organisms, the lowered reproductive potential of T. castaneum restricts the use of this tool to bring about a response to high selection for increased fitness. The mutation rates of genes controlling the quantitative trait of body weight were estimated to lie between 1.7×10^{-3} and 2.0×10^{-5} mutations/r/locus, the number of loci controlling this trait to be about 600, and the average effect of each locus to be about 1/30 of the standard deviation of body weight.

1311 Duxbury, R.E., Sadun, E.H. EFFECTS OF GAMMA-RADIATION ON DEVELOPMENT OF Dirofilaria uniformis IN Anopheles quadrimaculatus. Proc. helm. Soc. Wash. 30, 2 (1963) 263-5.

To determine the susceptibility of irradiated Anopheles quadrimaculatus to infection with Dirofilaria uniformis, female mosquitoes were exposed to γ-radiation of 10 000, 20 000 and 40 000 equivalent physical (rep) 24 h before they fed on infected cottontail rabbits. Ten days later a larger number of larvae was recovered from the irradiated groups as compared to non-irradiated controls, although the number was significantly greater only in mosquitoes given 10 000 rep. A similar experiment in which mosquitoes were irradiated at the same levels 24 h after infection, resulted in a significant reduction in the numbers and growth of larvae in irradiated mosquitoes as compared to their controls. With smaller doses there were no consistent differences in numbers, size, or location of developing larvae between experimental groups receiving 1000 and 2000 rep and the controls. At 4000 rep, however, significantly fewer larvae were recovered and most of them had developed only to the sausage stage. (Auth.)

1312 Kimeldorf, D.J., Hunt, E.L. MOTOR RESPONSES OF MOTHS TO LOW-INTENSITY X-RAY EXPOSURE. Science 140 (1963) 805-6.

A brief burst of x-rays elicited flight activity in moths placed in a darkened x-ray exposure room. Moths belonging to 8 species of Noctuidae and 1 species of Actiidae were used, amongst them Agrotis ypsilon. Wing-beat activity was recorded as an index of this behaviour. Wing-beat activity could be initiated in resting moths or amplitude augmented in active moths by x-ray dose rates of 0.01 to 1.5 r/sec, with a latency of < 1 sec after onset of exposure.

1313 Kritskiĭ, G.A., Ch'iwei, C. NUCLEOTIDE METABOLISM OF Galifria mellonella L. CATERPILLARS, NORMAL AND AFTER X-RAY IRRADIATION. Biochemistry USSR 26 (1961) 224-7. (English Translation).

In the composition of the acid soluble fraction of bee moth caterpillars there is found adenosine triphosphate, adenylic acid, and other low molecular weight purine and pyrimidine compounds. A day after x-irradiation of the caterpillars with a dose of 2000 r the total extinction of acid soluble compounds at 260 mμ decreases by 7%. The content of ATP falls by about 36%. Autolysis of the caterpillars in orthophosphate buffer solution a day after irradiation with a dose of 2000 r increases by about 86%. A considerable fall in ATP content and activation of autolysis in the period immediately after irradiation can be explained by the inhibition of oxidative phosphorylation after irradiation. (Auth.)

1314 Nardon, P. RÉPERCUSSION DE L'INFLUENCE DES RAYONS γ DANS LA DESCENDANCE DE Sitophilus sasakii Takahashi (Coléopt. Curcul.). C.R. Acad. Sci., Paris 254 (1962) 2454-6.

Les expériences sont conduites à la température de 27,5° et 75% d'humidité. Le poids n'a été mesuré que chez les descendants d'irradiés à 8000 r. Parallèlement à l'action sur le poids, on note une diminution de la fertilité chez les descendants d'irradiés, aussi bien à 5000 r qu'à 8000 r. L'irradiation des parents a pour conséquence de diminuer la fertilité et le poids des descendants, et d'augmenter leur durée de développement. Ces effets se transmettent d'une génération à l'autre sans qu'il soit besoin de recourir à la sélection.

Alors que les deux premiers tendent à disparaître, l'augmentation de la durée du développement est stable pendant au moins dix générations. (Aut.)

1315 Pelerents, C. INVLOED VAN GAMMASTRALEN OP OVERWINTERENDE BIJEN. (The effect of γ-rays on overwintering bees). Meded. Landbsch. OpzoekSt. Gent 27, 3 (1963) 896-907. (In Flemish).

The mutagenic and stimulating effects of γ-rays were investigated with a view to possible improvement in bee genealogy. Unfertilized and fertilized queens were irradiated involving, in the latter, irradiated sperm in addition to egg stages. Since artificial insemination gives good results irradiation of drones at some later stage is also envisaged. Changes induced by doses from 10 000 - 100 000 rads in the feeding rate were investigated. The longevity-dose relation was illustrated graphically. A reduction in longevity of 0.5 - 0.6 d/10 000 rads was observed. The mean life span of 26 d dropped to 20.9 - 18.7 d after irradiation with 2000 rads; 10 000 rads caused a 30% and 80 000 rads a 65% reduction, down to a life span of only 3.5 d. Wax production decreased with increasing doses. Little difference was observed between the effects of 40 000 and 50 000 rads. As bees grow older an increase in wax production is noted, possibly due to the physiological maturation of the winter brood which, like the summer brood, has to perform successively a variety of functions before wax is produced. The construction of a queen cell can be observed when the dose has not exceeded 10 000 rads.

1316 Po-Chedley, D.S. EFFECTS OF X-RAYS ON MEAL WORM EMBRYOS. Progress report. TID-19463, D'Youville Coll., Buffalo. 1963. 6p

The 17 free amino acids and the 3 derivatives previously reported for the 1- and 4-d-old embryos were found represented for almost all the remaining days of embryological growth. These compounds showed, generally, an increase in concentration ranging from 152.7 mg per cent for 1-d through 176.7 mg per cent for 8-d-old embryos. Two major irradiation responses may be distinguished in the meal worm: (1) during the first 4 d of growth, irradiation affects the yolk proteins and free amino acid relationships, which results in general metabolic disturbance, preventing the build-up of the essential amino acid reserve, and culminates in the death of the embryo; (2) although irradiation of the embryo from the 4th day appears to institute amino acid variations from the normal, a recovery or restoration does occur. This positive response may be facilitated by the high reserve concentrations of free amino acids accumulated at this stage of embryological development. Two tables give changes in ninhydrin-positive compounds detected at various developmental stages, in controls and in irradiated embryos.

1317 Po-Chedley, D.S. THE EFFECTS OF X-IRRADIATION ON THE FREE A-AMINO NITROGEN FRACTION OF THE MEAL WORM, Tenebrio molitor, OVA. (Abstr. D1B345) p.78 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

The present project is directed towards the internal environment of the insect which is rich in free amino acids. Reportedly, as amino acids have some protective potential, the radio-resistance of insects may be interpreted, in part at least, by that bio-chemical consideration. The current aspect of the study is concerned with metabolic differences in biochemical properties detectable during various stages of embryological growth of the meal worm. Data obtained for the meal worm embryo indicates that radiation resistance increases with embryological age, that the ova are rich in free amino acids, that ova exposed to sublethal (damaging) doses of x-rays liberate a labile factor (protein) which disappears as the embryo continues its growth and development. These considerations of the internal mechanism operating for the replenishment of the metabolic pool via protein degradation and the interplay of amino acids with the associated recovery-restorative processes are being examined.

1318 Wharton, D.R.A., Wharton, M.L. EFFECTS OF RADIATION ON NITROGEN AND PHOSPHORUS EXCRETION BY THE COCKROACH, Periplaneta americana L. Rad. Res. 14 (1961) 432-43.

Starved male cockroaches exposed to 10 000 rads of β-rays consume more water than unirradiated controls. They excrete more N_2 than controls. The difference is pronounced soon after irradiation and continues for several days, after which there is a rise in output by the controls while the N_2 excretion by the irradiated cockroaches continues to decline. The adult excretes very little of its N_2 as uric acid; the identity of the nitrogenous constituents remains to be investigated. P excretion by the irradiated cockroaches follows a different pattern from that of total N_2 or uric acid. There is no significant difference between the 2 groups during the 1st week, however, during the 2nd week the irradiated insects excrete less than the controls. Excretion by the controls rises between the 7th and 12th day in the manner of N_2. The inorganic P excreted by the cockroach is orthophosphate. There is no strong evidence that the radiation injury is centered in the nucleic acids under the conditions of radiation used, and it is suggested that increased cellular permeability may be the primary lesion. (Auth.)

centered in the nucleic acids under the conditions of radiation used, and it is suggested that increased cellular permeability may be the primary lesion. (Auth.)

See also:

48 L'abeille et la radioactivité. (Nordau, 1962)
745 Entomological aspects of radiation as related to genetics and physiology. (Grosch, 1962)
994 Latent radiation damage and synchronous cell division in the epidermis of an insect. III. Spontaneous reversal of effects leading to delay during mitosis. (Baldwin, 1961)
1181 Mechanism of resistance to virus diseases in the silkworm Bombyx mori (IV) (V) (VI). (Aruga, 1958)
1182 Studies on the induction of nuclear and cytoplasmic polyhedroses by treating with x-rays and ultraviolet light in the silkworm, Bombyx mori L. (Aruga and Yoshitake, 1961)
1183 15. Induction of virus infections. 2. Ultraviolet light and x rays. (Aruga, 1963)
1184 Histochemical and ultrastructural modifications in the mesenteron of Dacus oleae Gmel. induced by ionizing radiations. (Baccetti et al., 1961)
1188 On polyhedral disease in the silkworm induced by x-rays. (Karpov, 1959)
1244 Arrested development in x-rayed larvae of Ephestia kuehniella Zeller (Lepidoptera: Phycitinae).
1257 Effects of gamma radiation on codling moth eggs. (Hough, 1963)
1288 Effect of Co^{60} gamma rays on the small cutworm. (Sidorova, 1963)
1306 The bioelectrical response of the insect eye to beta radiation. (Smith and Kimeldorf, 1963)
1321 A theory of the improved performance and survival produced by small doses of radiations and other poisons. (Sacher and Trucco, 1962)
1337 The effect of X-radiation on longevity, emergence and DDT-susceptibility of the house fly. (Varzandeh and Moos, 1963)
1372 X-ray effects on single and mixed species populations of Tribolium confusum and Tribolium castaneum (Coleoptera: Tenebrionida.)
1374 Reactions to X-rays of a normal and a HCN-unsusceptible stock of Drosophila melanogaster. (Lüers, 1963)
1414 Effects of radiation on ecological systems. (Erdman, 1963)

I-B-5 SENESCENCE AND LONGEVITY

I-B-5-a GENERAL

1319 Muller, J.J. MECHANISMS OF LIFE-SPAN SHORTENING. p.235-45 in "Cellular Basis and Aetiology of Late Somatic Effects of Ionizing Radiation". A symposium held in 1962. Harris, R.J.C., Ed. New York, Academic Press. 1963.

Reasons are presented for concluding that spontaneous aging is a part of normal development caused, like most other developmental changes, by other factors than permanent genetic alterations such as point-mutation, deficiency, chromosome loss or inactivation, or segregation, even though it does involve the pointwise death of many individual somatic cells. These reasons comprise the partial reversibility of natural aging, and its independence of ploidy and of other features of chromosome structure. Judged by the same criteria, radiation-induced shortening of the life-span is an expression of point-wise losses of individual cells that are caused by actual genetic changes. That the changes are for the most part recessive, depending on either point-mutations, deficiencies, or whole-chromosome losses, is shown by results in Drosophila, Habrobracon, and plant material, when effects on individuals of different ploidy are compared. Tests of diverse kinds carried out with Drosophila having chromosomes of different structural constitution show clearly that the mechanism here at work is that of chromosome loss, caused by radiation-induced chromosome breaks. It is believed that the same basic mechanism accounts also for most of the acute damage that is produced by radiation. (Auth.)

1320 Oster, I.I. RADIATION EFFECTS ON GENETIC SYSTEMS. p.45-50 in "Proceedings of the Conference on Research on the Radiotherapy of Cancer, University of Wisconsin, Madison, Wisconsin, 16-18 June 1960". American Cancer Society, Inc. 1961.

Some of the consequences of x-ray-induced damage in the hereditary material of somatic cells is discussed. Sufficiently large doses applied to the larval stages will cause some deaths during subsequent pupal and imaginal stages. On the basis of survival rates of x-irradiated strains of Drosophila melanogaster, each containing chromosomes differing in structure, it has been suggested that premature aging in animals is brought about by chromosome loss produced by radiation. The possibility that this phenomenon is also involved in other radiation-induced effects, such as tumour formation and tumour regression, is also considered.

1321 Sacher, G.A., Trucco, E. A THEORY OF THE IMPROVED PERFORMANCE AND SURVIVAL PRODUCED BY SMALL DOSES OF RADIATIONS AND OTHER POISONS. p. 244-51 in "Biological Aspects of Aging". Schock, N.W., Ed. New York and London, Columbia University Press. 1962.

Recent evidence is reviewed on some paradoxical effects of ionizing radiations, especially as manifested in decreased disease incidence and increased expectation of life, based on observations on rats, mice and insects. A theory is proposed which accounts for the class of phenomena discussed. The characteristic damaging or depressant action of large doses is considered to be also produced by the smallest dosages known to produce paradoxical stimulation, and represents an essential step in the whole argument.

1322 Алимджанов, Р.А., Хакимова, Р. ДЕЙСТВИЕ ИОНИЗИРУЮЩИХ ИЗЛУЧЕНИЙ НА ЖУКОВ - ВСХОДОВЫХ СЛОНИКОВ. Докл. АН Узб. ССР 3 (1962) 65-6.

Alimdzhanov, R.A., Khakimova, R. EFFECT OF IONIZING RADIATION ON Sitona WEEVILS. Dokl. Akad. Nauk Uzb. SSR 3 (1962) 65-6.

Beetles (Sitona humeralis and S. cylindricollis) were collected in the field and exposed to Co^{60} radiation in doses up to 100 000 r. Irradiation failed to show any substantial effect on either the fecundity or life-span of the beetles. (For more complete abstract see Referat. Zhur., Biol., 1963, 4E203)

1323 Baxter, R.C. RADIOBIOLOGIC STUDIES WITH Drosophila. (Abstr. AIB1006) p. 14 in "Research and Development in Progress. Biology and Medicine. Issue No. 2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Somatic studies of D. melanogaster are centred about the effects of irradiation upon accelerated aging and longevity. Some of the variables that have been or will be used are acute versus chronic irradiation, certain mutant genes singly or in combination, hybridization, stage of the life cycle, age of the adult, temperature, nutritional stage, and O_2 tension. A few other species of Drosophila have been obtained and are being used for interspecific comparisons with D. melanogaster. (Auth.)

1324 Clark, A.M. SOME EFFECTS OF X-IRRADIATION ON LONGEVITY IN Habrobracon FEMALES. Rad. Res. 15 (1961) 515-9.

Habrobracon females, when exposed to x-rays as larvae, pupae, or adults, show a decrease in adult life span which is shortened in proportion to the amount of radiation delivered. Radiation damage to larvae and pupae, which cannot be detected simply by observing the incidence of adults that emerge, is revealed when adult life span is measured. Groups irradiated as adults at the doses delivered show no immediate mortality. The time of onset of death within the group depends on the amount of radiation delivered. Death is delayed for a longer time for smaller doses. Although adults will survive a dose of 200 000 r, as little as 5000 r causes a reduction in life span. (Auth. summary)

1325 Clark, A.M., Rubin, M.A. THE MODIFICATION BY X-IRRADIATION OF THE LIFE SPAN OF HAPLOIDS AND DIPLOIDS OF THE WASP, Habrobracon sp. Rad. Res. 15 (1961) 244-53.

Haploid males, diploid males, and diploid females (honey-water- or Ephestia-fed), were irradiated as larvae-in-cocoons, white pupae, and adults, and their adult life span obtained. The differential sensitivity of haploid and diploid adults to x-irradiation indicates that gene action is taking place in the adult stage and in non-dividing cells. Pupae after exposure to 10 000 and 15 000 r are not inhibited in their ability to develop into structurally normal adults which do, however, show a decrease in life span. This is much more apparent in the haploids. Larvae (after 2000 r) also develop into structurally normal adults, but with a decreased life span. The differential sensitivity of haploids and diploids is different for the larval, pupal, and adult stages. This is probably related to different types of genetic injury such as effects on cell division and on gene action occurring in different stages of development.

1326 Clark, A.M., Bertrand, H.A., Smith, R.E. LIFE SPAN DIFFERENCES BETWEEN HAPLOID AND DIPLOID MALES OF Habrobracon serinopae AFTER EXPOSURE AS ADULTS TO X RAYS. Amer. Nat. 97 (1963) 203-8.

The life span for haploid and diploid males was determined after exposure as adults to 60 kr of x-rays. The diploid males have a longer duration of life than the haploid males. This indicates that the decrease in life span after irradiation is related to damage to the chromosomal material. Non-irradiated diploid and haploid males have the same life span. The primary damage leading to a decreased life span is different for the irradiated and non-irradiated groups. The mechanisms involved in the normal aging process are different from those involved in the decreased life span from x-irradiation. (From auth. summary)

1327* Donnelly, J. THE EFFECT OF GAMMA RADIATION ON THE VIABILITY AND FERTILITY OF Lucilia sericata Mg. (DIPT.) IRRADIATED AS PUPAE. Ent. exp. appl. 3, 1 (1960) 48-58.

Pupae were subjected to a range of γ-doses from a Co^{60}-source. Observations were made on the percentage subsequently emerging after each treatment, and their longevity. Fertility was measured by caging each sex with untreated flies of the opposite sex, the numbers of hatching egg clusters obtained providing an index of fertility of the treated component. Percentage emergence, in pupae more than 3 d old at irradiation, was normal up to 12 000 rep, and reduced by about 24% after 24 000 rep. Adult longevity was progressively reduced by doses from 1000 rep upwards, and was about 50% of the control value after 9000 rep. The percentage viability of eggs from treated females decreased in the dosage range 0-2000 rep without any decrease in total eggs produced, after 3000 rep and above females failed to lay any eggs. Male fertility was about 3% after 3000 rep; above 3000 rep males were completely sterile. Morphologically normal sperm was produced by males at all doses up to 24 000 rep, and showed motility up to 6000 rep at least. Pupae irradiated before completion of $\frac{1}{3}$ of the total duration of the pupal stage failed to emerge after 3000 rep; those irradiated after that stage emerged normally after 12 000 rep. There was evidence that the transition from susceptibility to resistance was abrupt and that the physiological age of the pupae corresponding to this resistance threshold was independent of velocity of pupal development. (From auth.)

1328 Gowen, J.W., Stadler, J. A QUANTITATIVE STUDY OF LIFETIME SICKNESS AND MORTALITY AND PROGENY EFFECTS RESULTING FROM EXPOSURE TO PENETRATING IRRADIATION. Summary of Progress and Contemplated Work Program, Fiscal Year 1961-62. TID-13216, Iowa State Univ. of Science and Tech., Ames. 113p.

Progress is reported in studies on the effects of radiation on life shortening and aging. Data are included from studies on sex determination as illustrated by x-ray induced chromosomal and gene reorganization in Drosophila.

1329 Mahrous, M.A., Roston, Z.M.F. EFFECT OF X-RAYS ON THE DURATION OF LIFE OF THE RICE WEEVIL, Sitophilus oryzae L. Int. J. Rad. Biol. 5, 2 (1962) 191-3.

A highly significant shortening of the mean duration of life at 2000 r and at all larger doses was observed, irradiation being carried out on adults. On appropriate plotting of radiation data for both sexes it becomes clear that for doses of 5000 r and upwards an exponential relation exists between mean life span and dose. This relation, however, is not valid at < 5000 r. Maximum life span was considerably increased by doses 1000 - 4000 r, as compared with unirradiated controls. The exponential relation between mean duration of life and dose fails just at the point where prolongation of the maximum life span begins.

1330 Nöthel, H. THE INFLUENCE OF X-RAYS ON LONGEVITY, FECUNDITY AND FERTILITY OF Drosophila melanogaster. Int. J. Rad. Biol. 6, 4 (1963) 381-2.

The effect of 17 different doses of x-rays (100 kV, 0 - 125 kr) on Berlin-wild stock were tested, treated at 24 - 48 h of age. Fertility: - Development of imagoes could no longer be detected after irradiation (11 kr, 1.3×10^{4} eggs) of both sexes. At lower doses, some fertility was recovered around the 13th day in males and the 5th day in females. Longevity: - (a) The mean survival-time of the males decreases nearly linearly from 37 d (0 r) to 2.6 d (125 kr) when plotted against a logarithmic raster of increasing doses. In the same raster the curve for the females decreases from 20 d (0 r) to 18 d (3 kr), increases to a maximum of 29 d (11 kr) and then decreases again, running above the curve of the males. (b) A maximum in percentage mortality at each dose lies around the days of mean survival-time. Beginning with 90 kr a 2nd maximum arises on the 3rd day, increasing with dose, and involving nearly 100% at 125 kr. A change in type of mortality apparently occurs at the highest doses. Fecundity: - In controls, fecundity increases to a maximum on the 3rd day, decreasing subsequently with age of ♀♀. After irradiation up to 6 kr, fecundity is characterized by values equal to controls in the first 2 d; a minimum on the 3rd day; a maximum on the 5th day (only at 2 kr equalling 0 r values again); a decrease with age of ♀♀ in the following days, broken by another maximum on the 8th day at 3-4 kr. At 11 kr and above, fecundity decreases from the first 2 d to total sterility on the 8th day. Even at 90 kr a considerable amount of eggs can be found in the first 2 d. A comparison of data on fecundity and female longevity reveals a correlation between the doses at which fecundity ceases altogether and maximum life-span. Arrested fecundity appears to involve a factor for prolonging life-span. To test this, a dose of the mutagenic cytostaticum TEM, adequate for sterilization, was used in another experiment. The survival time was extended to 158% of the controls (11 kr). (From abstr.)

1331 Sacher, G.A. EFFECTS OF X-RAYS ON THE SURVIVAL OF Drosophila IMAGOES. TID-14624, Argonne National Lab., Ill. Oct. 1961. 41p.

See 1332.

1332 Sacher, G.A. EFFECTS OF X-RAYS ON THE SURVIVAL OF Drosophila IMAGOES. Physiol. Zoöl. 36, 4 (1963) 295-311.

Newly emerged male Drosophila melanogaster were exposed to x-rays at 1, 2, or 3 d intervals for the duration of life. Mean exposure rates ranged from 1 to 20 kr/d. Mean after-survival (MAS) of 10 control groups, comprising 3342 flies, was 28.9 d. The 5 exposure groups (1900 flies) at levels from 1.5 to 3 kr/d had pooled MAS of 38.5 d. From 3 to 20 kr/d MAS decreased steadily with increasing daily dose. Similar dosage-survival relations have been reported for Tribolium, Habrobracon and Drosophila. A detailed analysis of the components of variance of survival times within and between treatments is given. Control groups showed great heterogeneity of all variance components. A consistent effect of periodic exposure is to decrease variance and heterogeneity between treatments and between vials within treatments. The hypothesis is proposed that the increase in MAS is secondary to the decrease in the environmental variance components of exposed groups. The environmental variance is considered to measure the action of random environmental variables, primarily deleterious in nature, and radiation exposure reduces their effectiveness. It is not yet possible to decide whether the radiations act primarily by reducing the magnitude of the random variables or by increasing the resistance of the exposed insects. (Auth.)

1333 Sonnenblick, B.P., Grodis, J. CAN A DOSE OF 4-5000 r OF X RAYS DOUBLE THE LONGEVITY OF D. melanogaster? Drosophila Inform. Serv. 37 (1963) 130.

Attempts were made to confirm the report of Strehler that x-ray doses of 4000-5000 r double the longevity of D. melanogaster. Several tests were conducted on a Canton-S strain maintained in mass culture on standard media. Radiological factors were the same in all tests (90 kVp, 5 mA, no added filter, 960 r/min as measured in air), but other factors differed. In one study, 1-d-old flies of both sexes were exposed, while in the other 7-d-old flies were irradiated. They were kept for 3 or 4 d, respectively, in mass culture, etherized, and then two pairs of males and females were placed in separate vials. Unirradiated flies were similarly treated and observations were made regularly. After the 2nd week, vials were changed every 7 d. When 1-d-old flies were exposed to 4000 r of x-rays, it was found that the mean life span of combined females and males was 47.6 d and that of the controls was 46.2 d. When 7-d-old flies were treated, the mean longevity of irradiated (4000 r) adults of both sexes was 46.4 d while that of controls was 44.2 d. It is concluded that an x-ray dose of 4000 r does not double the mean life span of treated as against untreated flies, and that a dose as large as 4000 r does not seem to influence life span significantly. (NSA 17: 1963, 35501)

1334 Strehler, B.L. FURTHER STUDIES ON THE THERMALLY INDUCED AGING OF Drosophila melanogaster. J. Geront. 17 (1962) 347-52.

It was found that exposing Drosophila to ionizing radiation actually extends life expectancy, rather than shortens it. The effect of irradiation on the mortality rate, such as to produce an extension of life, was largely lost or absent when the flies were reared under absolutely aseptic conditions. It was also shown that the regular replenishment of the housing and food of individually housed Drosophila produces a considerable extension of the life span. Thermal shock exposures at 38.5°C for periods ranging from $\frac{1}{2}$ to 3 h (in fractionated dosages) resulted in a significant increase in the age-specific mortality rate of the flies surviving beyond 7 d after the exposure. The results suggest that denaturative processes may mimic the effects of time on the aging of Drosophila as reflected in mortality rates.

1335 Taylor Univ., Upland, Ind. THE EFFECT OF X-RADIATION ON LONGEVITY IN Drosophila melanogaster. Technical Progress Report. TID-11562. 1961. 11p.

The length of life, in days post eclosion, has been investigated for irradiated and control groups of flies. The irradiated flies received 2450, 4000, 5000, and 10 000 r of x-radiation. The medium used is described. The longest mean life for females was 62.6 d (determined for 166 flies) at 2450 r, the shortest mean life for males was 34.13 d (for 133 flies) at 18 000 r. Lower amounts (2450 r and 5000 r) seem to increase life span, 18 000 r to decrease life span for all flies. Results are illustrated in 3 graphs.

1336 Taylor Univ., Upland, Ind. THE EFFECT OF X-RADIATION ON LONGEVITY IN Drosophila melanogaster. Technical Progress Report. (TID-14970. n.d. (1962?) 26p.

Data are presented for the length of life post eclosion for control and irradiated groups of flies from a crossed strain. The amounts of radiation used were 25 r for eggs; 250 r for larvae; 250, 2500, 7500 and 15 000 r for imagoes. Both mated and unmated groups were studied. The results indicate that (1) irradiation lowers the life of imagoes, although inconsistent results were obtained for imagoes from irradiated larvae and eggs, and that (2) females outlive males in both irradiated and control flies. (NSA 16: 1962, 11459)

1337 Varzandeh, M., Moos, W.S. THE EFFECT OF X-RADIATION ON LONGEVITY, EMERGENCE, AND DDT-SUSCEPTIBILITY OF THE HOUSE FLY. Proc. Ent. Soc. Amer. No. Cent. Br. 18 (1963) 55-9.

1338 Tobari, I., Moriwaki, D. RELATIONSHIP BETWEEN Y-CHROMOSOME AND LONGEVITY IN Drosophila melanogaster, ESPECIALLY IN TERM OF THE RADIATION EFFECT. p.152-4 in "Proceedings of the Symposium on Genetic Effect of Radiation, Mishima, 7-8 November 1960". Jap.J. Genet. 36, Suppl. The Genetics Society of Japan. 1961. (In English).

The types of strains used are described. The suggestion is put forward, on the basis of the experimental data obtained, that fertility factors may exist together with longevity factors in the Y-chromosomes. 900 r (x-)irradiation of XXY females may cause the fertility factors to be destroyed in the Y-chromosome, whereas 1800 r may cause both to be destroyed.

1339 Wood, V.G. THE EFFECT OF X-RADIATION ON LONGEVITY IN Drosophila melanogaster. Technical Progress Report. Taylor Univ., Upland, Ind. Jan. 1963, n.p.

A suitable strain (wild P-1x4) was used. Radiation doses were 25, 250, 500 r for eggs; 500, 1000 r for larvae; 250, 1250, 5000, 7500, 15 000, 30 000, 45 000 r for imagoes. Both mated and unmated groups were studied. Eggs showed a significant life shortening for both males and females after 250 and 500 r, as did imagoes from irradiated larvae (250 r). Mated flies from such larvae showed a significant increase in life span (females lived 50.1 d, S.D. 13.3, when irradiated and 46.7 d, S.D. 14.1, in controls; males 52.0d (S.D. 18.98, and 45.5, S.D. 14.4). Longest mean life obtained in days post eclosion for irradiated imagoes was for unmated females, given 1250 r. With radiations ≥5000 the life span is of the same order or longer than in controls, but there are significant decreases above that irradiation level. In general, females seem to outlive males both with irradiated and control flies, and unmated flies outlive mated flies. Males seem more vulnerable to radiation than females.

See also:

470 Effects of ingested Pu^{239} on fecundity, fertility and life span of Habrobracon (Hymenoptera: braconidae). (Erdman, 1962)
471 Effects of irradiation on the Mediterranean meal moth Ephestia kuehniella Zeller, cultured on Sr^{89}-spiked food. (Erdman, 1962)
476 Certain biological effects produced in the boll weevil by tagging it with P^{32}. (Mayer and Brazzel, 1961)
775 Irradiated parasitic wasps, the effect on progeny production and sex ratio. (De Bach and White, 1963)
778 Effects of irradiating single and mixed species of beetles. (Erdman, 1961)
781 Effect of gamma radiation on the fertility of Aëdes aegypti. (Ghosh et al., 1961)
782 The effect of ionizing radiation on the biology and ecology of Rhodnius prolixus, the principal vector of Schizotrypanum (i.e. Trypanosoma) cruzi in Venezuela.
783 Effects of gamma radiation on the fertility and longevity of Drosophila melanogaster. (Henneberry, 1963)
790 Influence de l'irradiation sur les adultes de Sitophilus sasakii Takahashi (Curculionidae) et leurs descendants.
791 Action des rayons γ du $cobalt^{60}$ sur la mortalité et la fertilité des adultes d'un charançon du riz. (Laviolette and Nardon, 1963)

804 Quelques résultats supplémentaires concernant l'influence des rayons gamma sur les chrysalides et les oeufs de la teigne de la farine "Ephestia kuehniella Z.". (Pelerents, 1963)
810 Action des rayons γ sur la stérilité d'une noctuelle du coton (genre Laphygma exigua). (Rasulov, 1963)
855 The action of radiation and other mutagenic agents (1) in inducing mutation in Drosophila females, and (2) in controlling the action of specific genes responsible for supressing uncontrolled growth. (Glass, 1962)
973 Effects of x-rays on salivary-gland chromosomes during early stages of development. (Senglin, 1958)
1090 The influence of radiation in altering the incidence of mutations in Drosophila. (Muller, 1963)
1093 Phase cinematography studies on the effects of radiation on the cell, with special regard to the behaviour of the chromosomes in grasshopper spermatocytes in response to x- and beta-irradiations. (Nakanishi et al., 1961)
1217 Comparative study of radiation sensitivity of different strains of Drosophila melanogaster. (Vorobtsova, 1963)
1237 Control of the Mediterranean flour moth Anagasta kühniella Zell by sterile male release. II. Susceptibility to gamma radiation. (Bull and Wond, 1963)
1257 Effects of gamma radiation on codling moth eggs. (Hough, 1963)
1260 Studies on the breeding method taking advantage of γ-rays in the silkworm. (Japan. Sericultural Experiment Station, Tokyo. 1963)
1276 Studies on the biological influence of the termites exposed to Co^{60} gamma source. I. Influences on the adult of Formosan termite and its offspring. (Nakajima et al., 1963)
1315 The effect of γ-rays on overwintering bees. (Pelerents, 1963)
1344 Lethal effects of X-rays on the housefly, Musca domestica L. (Grasso et al., 1962)
1345 Lethal effects of X-rays on Musca domestica L. (Grasso et al., 1963)
1348 The LD_{50} for gamma radiation in Drosophila melanogaster. (Ives et al., 1955)
1352 Different types of mortality including prolongation of female lifetime after x-raying Drosophila melanogaster imagines. (Nöthel, 1963)
1372 X-ray effects on single and mixed species populations of Tribolium confusum and Tribolium castaneum (Coleoptera: Tenebrionida. (Erdman, 1962)
1373 The differential sensitivity of flour beetles, Tribolium confusum and T. castaneum to x-ray alteration of reproductive abilities, induced dominant lethals, biomass, and survival. (Erdman, 1963)
1384 Effects of temperature and x-ray irradiation on intrinsic growth rate in populations of Drosophila pseudoobscura. (Tantawy, 1963)
1407 Developmental homeostasis in x-rayed populations of Drosophila pseudoobscura. (Tantawy, 1963)
1427 Effects of ionizing radiation on insects and other arthropods. (Stone, 1963)
1452 Possibilities of eradication of the Mediterranean fruit fly Ceratitis capitata Wied. from Central America by gamma-irradiated males. (Katiyar, 1962).
1455 Sterilization of the Mediterranean fruit fly and its application to fly eradication. (Katiyar and Valerio, 1963)
1469 Control of the Mediterranean flour moth Anagasta kühniella Zell. by sterile male release. I. Biological studies related to large scale rearing. (Bull and Wond, 1962)

I-B-6 LETHAL EFFECTS

1340 Dennis, N.M. THE EFFECTS OF GAMMA-RAY IRRADIATION ON CERTAIN SPECIES OF STORED-PRODUCT INSECTS. J. econ. Ent. 54, 1 (1961) 211-2.

An exposure to 100 800 r at an average dose rate of 4200 r γ-rays/h killed all Tribolium confusum Duv. adults and larvae, Oryzaephilus surinamensis (L.) adults, Rhizopertha dominica (F.) adults, Sitophilus granarius (L.) adults, Sitophilus oryzae (L.) adults, Plodia interpunctella (Hbn.) larvae, and Ephestia cautella (Wlk.) larvae within 2 months. An exposure to 151 200 r killed O. surinamensis adults, Tribolium adults and larvae, and P. interpunctella within 6 d. Tribolium exposed to 8400 r did not reproduce during a 2-month period after exposure. Two tables are included.

1341* Ducoff, H.S., Walburg, H.E., Jr. RESPONSE OF Tribolium LARVAE TO X-IRRADIATION. (Abstr. 140) Anat. Rec. 137 (1960) 351.

The effects of x-rays on larvae of Tribolium confusum maintained in a flour-yeast medium are described. When young larvae are exposed to 5 kr and incubated at 23°C, deaths begin to occur in a few days, but are scattered throughout the larval period; with older larvae, death may occur during pupation or upon emergence of the adult. Incubation at 30°C accelerates larval development and lethality to about the same extent, without significantly changing the proportion surviving. Conversely, incubation at 18°C delays both development and death. Doses ⩾ 4 kr markedly delay onset of pupation. (From abstr.)

1342 Frizzi, G., Jolly, M.S. MUTAZIONI INDOTTE CON RAGGI X IN Anopheles maculipennis. (X-ray-induced mutations in Anopheles maculipennis) Atti Ass. genet. ital. 6 (1961) 285-90. (In Italian, with English summary).

Adult males of A. mac. atroparvus were treated with x-ray doses of 2000 r, 2500 r, 4000r, 5000 r and 6000 r. The highest rate of chromosomal aberrations was obtained with 3500 r; 6000 r gave complete sterility. The most frequent types of mutations were inversions, both paracentric and pericentric; few deficiencies and translocations were found. The embryonic and larval mortality increases with the dose. Possible implications of applied radiogenetics of Anopheles are discussed. (Auth. summary).

1343 Ghosh, S.M., Hati, A.K., Basu, S.P. EFFECTS OF GAMMA RADIATION ON Culex fatigans EGG RAFTS. Bull. Calcutta Sch. trop. Med. Hyg. 9, 4 (1961) 156.

Exposure of recently deposited egg-rafts of Culex pipiens fatigans Wied. to x-radiation in doses up to 1500 r had no effect on time of hatching, and most of the eggs hatched gave rise to normal adults in the same time as did eggs that had not been irradiated. Observation of progeny up to the 5th generation revealed no abnormality. When the dose was 2500 r, few eggs hatched and the larvae died during development. It is concluded that the lethal dose is much lower than that for the eggs of Aëdes aegypti (L.) which require a minimum dose of 3000 r for lethal action. In irradiated C. fatigans egg rafts (2000 r), delayed effect of radiation was noticed. Death in every stage from egg to adult occurred. This was not seen in Aëdes.

1344 Grasso, A., Boccacci, M., Quintiliani, M. LETHAL EFFECTS OF X-RAYS ON THE HOUSEFLY, Musca domestica L. Sci. Rep. Ist. Super. Sanità 2, 3 (1962) 292-300.

Musca domestica L. at the adult stage is highly resistant to x-rays, and males and females show almost the same radiosensitivity. 60 000 r reduces the life span to one half. The insect at the preimaginal stages is much more radiosensitive. The LD_{50} is 800 r for 3rd stage larvae and 700 r for pupae. The lethal effects of x-rays can be reduced by anoxia (DRF = 1.6). Treatment with cysteamine or glutathione prior to irradiation is without influence. Iodoacetic acid, administered before irradiation, is able to enhance the lethal effects of x-rays (DRF = 1.39). (Auth.)

1345 Grasso, A., Boccacci, M., Quintiliani, M. LETHAL EFFECTS OF X-RAYS ON Musca domestica L. Int. J. Rad. Biol. 6, 4 (1963) 383.

The insect at the adult stage is highly resistant to x-rays. The dose which reduces the life-span to one half is 60 000 r and the LD_{50} at 24 h is 150 000 r. Males and females show the same radiosensitivity. The reduction of the average life-span shows a roughly linear correlation with the x-ray dose. The dose-reduction factor in the anoxic state (N_2) is about 1.6. Cysteamine and glutathione, injected 20 min before irradiation into the thorax at doses of 0.33 and 0.66 mg per gram of body-weight, respectively, do not afford any protection. Iodoacetic acid, given by tarsal contact at sub-lethal doses, is able to enhance the lethal effects of irradiation. In flies treated with iodoacetic acid, a dose of 65 000 r produces an effect for which 85 000 r would otherwise be necessary. Experiments carried out with various strains of housefly resistant to the most common insecticides have shown that there is no correlation between resistance to the insecticides and radiosensitivity. The pre-imaginal stages are much more radiosensitive, with LD_{50} of 800 r for 3rd-stage larvae and 700 r for pupae. (From abstr.)

1346 Gil y Gil, C. MEAN LETHAL DOSE FOR SILK WORM EGGS WITH RADIATION OF DIFFERENT WAVE LENGTHS. p. 211 in "Book of Abstracts, No. 336(b)". Tenth International Congress of Radiology, Montreal, 26 August - 1 September 1962.

1347 Huque, H. PRELIMINARY STUDIES ON IRRADIATION OF SOME COMMON STORED-GRAIN INSECTS IN PAKISTAN. p. 455-62 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

A dosage of 20 000 r γ-radiation produced 100% mortality of the adults of Rhizopertha dominica and Tribolium castaneum within a period of 11 d. A lower dose (10 000 r) was, however, effective in 23 d.

The adults of Sitophilus granarius evinced comparatively high susceptibility and when they were exposed to 10 000 r, total mortality was attained in 7 d. The larvae of Trogoderma granarium, however, proved to be the most resistant; they were not responsive to the lower dosages, and 100% control was attained only with 25 000 r in 26 d. The maximum dosage of 250 000 r gave an instant kill in all these cases, but apart from being too high it also adversely affected the viability of the grains. Since, however, their nutritive value remained unaffected, this treatment might be of use where immediate disinfestation of non-seeding edible grains was desired. Eggs of Bruchus quadrimaculatus failed to hatch when exposed to 2500 r. Studies on other stages and dosages are in progress. (From auth.)

1348* Ives, P.T., Heilman, R.S., Plough, H.H. THE LD_{50} FOR GAMMA RADIATION IN Drosophila melanogaster. (Abstr.) Genetics 40 (1955) 577.

Survival and mortality curves were constructed. Males proved relatively more sensitive to γ-radiation than did females. In terms of the median, mode and mean mortality for controls and 4 dosages (25 000 r to 100 000 r, at 255 r/min) the interpolated LD_{50} is near 40 000 r for males and near 60 000 r for females. After receiving 100 000 r males live for about 2 weeks and females for nearly 4 weeks before "radiation sickness" (Loss of co-ordination) begins, leading to death within a few days. After receiving 150 000 r flies walked normally, none could fly, only a few females could feed and lived longer than 1 d, dying within a week. After 200 000 r or 250 000 r flies showed only small unco-ordinated movements (similar to those in mild anaesthesia) greater at the lower dose in females than in males, followed by death within a few hours. Preliminary tests suggest that less than 10 000 r prevents further germ cell production, but occasional mature sperm produced fertile F_1 after receiving as much as 16 000 r. (From abstr.)

1349 Lovellette, E., Ratty, F.J. COMPARISONS OF INBRED AND RANDOM BRED LARVAL SURVIVAL TO 1200 r. Drosophila Inf. Serv. 36 (1962) 87-8.

1350 Mead, H.E., Muller, H.J. MORTALITY INDUCED BY X-IRRADIATION OF EARLY Drosophila EMBRYOS OF STRUCTURALLY DIFFERENT GENOTYPES. (Abstr.) Genetics 47, 8 (1962) 970-1.

Earlier work (Lamy and Muller 1939; Muller and Pontecorvo 1939-1942), utilizing offspring of triploid females, has shown that most mortality induced by x-irradiation of early embryos of Drosophila is caused by some process other than chromosome loss. We have recently reinvestigated this problem, by determining the influence of a second-chromosome deficiency (vg^{-B}) on this mortality. These experiments parallel those previously carried out in our laboratory by Ostertag (Thesis, 1961, and in press) and confirmed by ourselves on the influence of this deficiency on the mortality induced by x-irradiation of 3rd-instar larvae. 800 r were delivered to embryos in the polar-cap stage (extending from blastoderm formation to beginning gastrulation). The following rates of survival to the imaginal stage were obtained for the 4 genotypic classes of 2536 irradiated individuals, as expressed in terms of the frequencies of survivors after irradiation relative to (divided by) the frequencies of the same classes of imagoes obtained from 1094 non-irradiated (control) embryos derived from the same crosses: structurally normal females 48.4%, deficient females 55.5%, structurally normal males 62.4%, deficient males 63.1%. These results differ markedly from those obtained by Ostertag and by ourselves from irradiation of 3rd-instar larvae, which show much lower mortality among females than males and among nondeficient than deficient individuals. We conclude that irradiation kills these early embryos, unlike later stages, by a different process, for the most part, than chromosome loss. Our data show, moreover, that this mortality, unlike that induced by later irradiation, is concentrated within a relatively short postirradiation period.

1351 Nöthel, H. THE INFLUENCE OF X-RAYS ON THE VITALITY OF Drosophila melanogaster. STUDIES OF MORTALITY, FECUNDITY, AND FERTILITY AFTER VARIOUS DOSES. AED-DISS-63-288. Gmelin Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main. Thesis. Berlin. Freie Universität. 1963. 80p. (In German).

D. melanogaster of both sexes was irradiated with 100-kV x-rays using doses between 0 (controls) and 125 kr. Dose-effect curves for mortality are linear up to 90 to 100 kr. For higher doses other effects become important resulting in a higher mortality. Fecundity decreases with increasing doses up to 11 kr, when all females are sterilized. Mortality of offspring is proportional to dose. (Gmelin Inst.) (See 1330).

1352 Nöthel, H. DIFFERENT TYPES OF MORTALITY INCLUDING PROLONGATION OF FEMALE LIFETIME AFTER X-RAYING Drosophila melanogaster IMAGINES. (Abstr. 5.52) p. 72-3 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J. Ed. Oxford, Pergamon Press, 1963.

The influence of x-rays on the lifespan of D. melanogaster imagoes has been studied by application of 17 different doses (100 kV, 0-125 kr) to 1-2 d-old males and females of the Berlin wild stock. A prolongation of female lifespan is induced by doses >4 kr, it culminates at 11 kr in 150% of the mean survival time of unirradiated females. The prolongation is not accompanied by alterations in locomotion or copulation of the females concerned and is independent from radiation effects in the males mated with them. Measurements of fecundity have proved the prolongation to be correlated with the radiation-induced sterilization of the females. This has been confirmed furthermore by investigations with unirradiated virgin females having a low fecundity, with females of a special strain showing a high radiation resistance with regard to fecundity, and with chemically (TEM) sterilized females. In the males mean survival-time, T_{50}, T_{100}, and the time of the highest mortality decrease linearly when plotted logarithmically against a raster of linearly increasing doses. The LD_{50} of females (96 kr) appears to be twice that of males. The linearity of these curves is interpreted as an always identical type of damage. In both sexes the normal distribution of the post-irradiation mortality rate is altered at doses > 90 kr. A 2nd peak appears at the 3rd day, increasing with doses with a corresponding increase in the gradient of the declining survival time curve at 90-100 kr. A new type of mortality is apparently manifested at high doses. In agreement with the radiation syndrome at these doses it is interpreted as a central-nervous-death. (From abstr.)

1353 Ogaki, M., Tanaka, E. INHERITANCE OF TOLERANCE TO GAMMA RADIATION IN Drosophila melanogaster (Abstr.) Genetics 48, 7 (1963) 904-5.

2 or 3d-old flies from two wild strains (Hikone-H, Mino-H), and two mutant strains (bw; st ss and vg^8; se) of D. melanogaster were subjected to Co^{60} γ-radiation in doses ranging from 80 000 r to 180 000 r at approximately 90 000 r/h. The flies were kept 40/vial at 24±1°C and shaken to fresh food every 3 d. Survival and mortality curves were constructed. The sensitivity of males to radiation proved relatively higher than females. The interpolated LD_{50} of Hikone-H and Mino-H is near 150 000 r for females and near 130 000 r for males 7 d after irradiation; that of bw; st ss and vg^8; se, (which are more susceptible than the former) is then about 120 000 r for females, 100 000 r for males. The F_1 generation of a reciprocal cross between non-resistant and resistant flies was made. These hybrid flies showed almost the same resistability as the resistant strains; the LD_{50} of the hybrid females was near 150 000 r. From the above experiment, it is ascertained that the radiation tolerance was dominant over susceptibility, and material or cytoplasmic effects were negligible. In order to analyse which chromosome is responsible for tolerance, three special synthetic strains, I Hikone-H; bw; st ss, I; II Hikone-H; st ss and I Hikone-H; bw; III Hikone-H, were made. The level of resistability to Co^{60} radiation in the original resistant and susceptible strains, and that of the special synthetic three strains, were tested. The LD_{50} of I Hikone-H; bw; st ss and I; II Hikone-H; st ss was almost 120 000 r for females, which is just the same level as the susceptible one, whereas only the I Hikone-H; bw; III Hikone-H strain showed almost the same resistability as Hikone-H resistant strains; the LD_{50} of this synthetic stock was 147 000 r for females. From this experiment we assume that the tolerance to Co^{60} γ-rays in Drosophila is dominant and is controlled mainly by the 3rd chromosome.

1353-a Ostertag, W. THE GENETIC BASIS OF SOMATIC DAMAGE PRODUCED BY RADIATION IN THIRD INSTAR LARVAE OF Drosophila melanogaster. I. DEATH BEFORE MATURITY. Z. indukt. Abstamm.- u. VererbLehre 94, 2 (1963) 143-62. (In English)

Third-instar larvae of different genotypes were exposed to x-radiation of various doses (at 160 r/min and 240 r/min). The onset of pupation was noticeably delayed by doses ⩾ 3500 r, slightly by 3500-2800 r, and scarcely by 2450 r. Doses > 2800 r also prolonged the duration of the pupal period. Mortality before pupation was high at ⩾ 3500 r, negligible below. Most pupal deaths occurred immediately before eclosion. Serious deformities were also found, their number and extent increasing with dose. At > 4200 r almost 100% of flies were deformed (mostly wing size and phenocopies of "cut", and head abnormalities). Survival was scored separately for the sexes and genotypes. Most of the observed correlations agree with the hypothesis that some somatic radiation damage was exclusively (or nearly) due to chromosome breakage followed by chromosome loss, cellular damage or death resulting whenever a portion of the genome was no longer represented in at least haploid condition. Monosomaty for either of the long autosomes does not appear to be detrimental to somatic cells.

1354 Ross, M.H., Cochran, D.G. SOME EARLY EFFECTS OF IONIZING RADIATION ON THE GERMAN COCKROACH, Blattella germanica. Ann. ent. Soc. Amer. 56, 3 (1963) 256-61.

Large nymphs of the German cockroach have been exposed to ionizing radiation at two similar Co^{60}-sources. The insects received dosages ranging from 100 r - 9600 r. A number of effects of these total body irradiations became apparent shortly after exposure, and are described. Data are given on mortality occurring at the 6400 r and 9600 r levels, on male and female sterility at 3200 r, and on the progressive decrease in numbers of reproductive females, off-spring per egg case and normal ovarioles at the lower dosages. Dissections of both normal and irradiated males and females, showing visible effects of irradiation on the ovaries, testes and on spermatogenesis, are also described. An explanation of the decrease in reproductivity and the occurrence of sterility is made on the basis of the probable presence of dominant lethals and on information obtained from dissection. (Auth.)

1355 Stahler, N., Terzian, L.A. THE RESPONSE OF BLOOD-FED Aëdes aegypti TO GAMMA RADIATION. J. econ. Ent. 56, 3 (1963) 416-7.

The study was undertaken to check whether the survival of blood-fed females was significantly different from that of the non-blood-fed groups after whole-body irradiation from Co^{60}. Preliminary results are presented. The data clearly suggest an attenuation of radiation-induced lethality in blood-fed Aëdes aegypti, whether one considers the blood-fed or the non-blood-fed groups as the controls.

1356 Viado, G.B., Manoto, E.C. EFFECTS OF GAMMA RADIATION ON THREE SPECIES OF PHILIPPINE INSECT PESTS. p.443-53 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency, 1963.

Eggs, larvae, pupae and adults of Epilachna philippinensis Dieke on tomato, and adults of Sitophilus oryzae L. and Tribolium castaneum Herbst on corn were subjected to 1, 5, 10 and 20 kr γ-rays (Epilachna) and 10, 20, 40, 60 and 80 kr (Sitophilus and Tribolium), respectively. At 1 kr, the proportion of unhatched eggs in Epilachna was about 10%. There was no proportionate increase in mortality at 5 kr, but at 10 kr the mortality increased to more than 3 times that at 5 kr. Mortality at 20 kr was about 90%. The threshold dose seems to lie between 5 and 10 kr. The embryo of eggs that did not hatch failed to continue development. At 1 kr, over 20% of the larvae were killed, although some of these succeeded in pupating before they died. Most of the larvae attained the adult stage. All the larvae that survived the treatments above 1 kr, some for as long as 4 weeks, died without attaining the pupal stage. The pupae were more resistant than the larvae and the adults. Complete mortality was not attained even with 20 kr. Some adults which emerged in the 5-kr and 10-kr lots had abnormally developed wings and/or legs. In the adults, the 10 and 20 kr doses had an adverse effect, killing about 75% of the individuals subjected to the lower, and all subjected to the higher, dose 3 weeks after irradiation. No significant difference in susceptibility between the sexes was noted. About 40% of the S. oryzae in the lots treated with 60 and 80 kr were killed one week after irradiation, but only about 10% were killed with 20 kr and about 20% with 40 kr. The mortality with 40, 60 and 80 kr increased to about 75% two weeks after the start of the test. The mortality with 10 kr corresponding to this period was less than 10% and that with 20 kr was about 25%. The threshold dose seems to lie between 20 and 40 kr. The mortality trend in the T. castaneum was similar to that in the S. oryzae, except that the threshold dose seems to lie at about 40 kr. (From auth.)

See also:

472 The genetic and developmental effects of ingested radioactives in Habrobracon. (Grosch, 1960)
476 Certain biological effects produced in the boll weevil by tagging it with P^{32}. (Mayer and Brazzel, 1961)
761 Study of the dose-dependence on the survival rate and the sexual sterilization of the granary weevil (Calandra granaria). (Andreev et al., 1962)
774 Exploratory studies on gamma radiation for the sterilization of the boll weevil. (Davich and Lindquist, 1962)
790 Influence de l'irradiation sur les adultes de Sitophilus sasakii Takahashi (Curculionidae) et leurs descendants. (Laviolette and Nardon, 1963)
791 Action des rayons γ du cobalt 60 sur la mortalité et la fertilité des adultes d'un charançon du riz. (Laviolette and Nardon, 1963)
814 Studies on the genetic effect of radiation 1959-1960. II. Studies on the genetic effect of radiation with silkworm. (1) Differences between times of death of the F_1 after irradiation of oögonia or mature oöcytes. (Tazima and Onimaru, 1962)
820 X-ray induced "dominant lethals" in inseminated eggs of Drosophila. (b) Experiments with different stages between insemination and end of second cleavage division. (Würgler, 1963)
1013 A cytogenetic study of the effects of x-irradiation on Aëdes aegypti. (Rai, 1963)

1030 Variation of radiosensitivity during meiosis and early cleavage in newly laid eggs of Drosophila melanogaster. (Würgler et al., 1963)
1039 Relative effectiveness of 14 MeV neutrons and 200 kVp x-rays for production of lethality in grasshopper embryos. (Bicker, 1962)
1103 The influence of temperature upon the radiation susceptibility of Sitophilus granarius L. Pendlebury et al., 1962)
1104 Pathogenic effect of low and medium doses of gamma-rays on the progeny of irradiated insects. (Podolyan, 1963)
1155 Oxygen effect in newly laid Drosophila eggs. (Ulrich and Würgler, 1962)
1217 Comparative study of radiation sensitivity of different strains of Drosophila melanogaster. (Vorobtsova, I.E.)
1228 The susceptibility of the confused flour beetle (Tribolium confusum Duv.) to gamma radiation. (Banham, 1962)
1233 Developmental effects of x-ray induced euploid and near euploid mutants in heterozygous condition in Drosophila melanogaster. I. Delay in egg hatching and larval delay and death prior to pupation. (Baumiller, 1963)
1236 Effect of radiation on Mexican fruit-fly eggs and larvae in grapefruit. (Brownell and Yudelovitch, 1962)
1243 Response of Tribolium confusum to radiations and other stresses. (Ducoff and Bosma, 1963)
1244 Arrested development in x-rayed larvae of Ephestia kuehniella Zeller (Lepidoptera: Phycitinae). (Erdman, 1961)
1247 Comparative x-ray sensitivity of Tribolium confusum and T. castaneum (Coleoptera: Tenebrionidae) at different developmental stages during their lifecycle. (Erdman, 1962)
1251 Preliminary results on the effect of high energy photons on lettuce root growth and on Musca domestica. (Garsou, 1962)
1255 Effect of gamma-radiation on eggs of the silkworm. (Henneberry and Sullivan, 1963)
1256 Effects of 300 kV x-ray radiation on Sitophilus oryzae. (Hoover et al., 1963)
1261 The susceptibility of the saw-toothed grain beetle, Oryzaephilus surinamensis L. to gamma radiation. (Jefferies, 1962)
1262 Studies on the radiation sensitivity of Drosophila embryos. (Johansen, 1962)
1267 The effects of x-irradiation on the embryos of invertebrate animals. (Larsen, 1962)
1272 Sensibilité aux rayons X de la durée de développement des oeufs de Bombyx mori lorsque l'irradiation est effectuée quelques heures après le début de l'incubation.
1275 Studies on the effects of gamma radiation on the different developmental stages of the Khapra beetle, Trogoderma granarium Everts. (Nair and Rahalkar, 1963)
1279 Mortality of irradiated pre-imaginal stages of Drosophila. (Oster and Cicak, 1958)
1284 Influence of gamma radiation on the development and fertility of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962)
1285 Radiosensitivity of various stages of Callosobruchus chinensis L. (Quraishi and Metin, 1963)
1288 Effect of Co^{60} gamma rays on the small cutworm. (Sidorova, 1963)
1289 Histological investigation on the "premature death" of x-irradiated Drosophila eggs. (Steenbeck, 1961)
1293 Studies of the genetic effects of irradiation during the perifertilization stages of Drosophila melanogaster. (Valencia and Valencia, 1962)
1320 Radiation effects on genetic systems. (Oster, 1961)
1328 A quantitative study of lifetime sickness and mortality and progeny effects resulting from exposure to penetrating irradiation. (Gowen and Stadler, 1962)
1330 The influence of X-rays on longevity, fecundity and fertility of Drosophila melanogaster. (Nöthel, 1963)
1331 Effects of x-rays on the survival of Drosophila imagoes. (Sacher, 1961)
1359 Biological effectiveness of 30-MeV electrons in dependence on the tissue depth and in comparison with 180-keV and 31-MeV photons. I. Lethality test on one-hour Drosophila embryos. (Fritz-Niggli and Schinz, 1961)
1360 Biological effectiveness of 30-MeV electrons depending on tissue depth and in comparison with 180-keV and 31-MeV photons. II. Lethality tests on four-hour old Drosophila embryos. (Fritz-Niggli and Schinz, 1962)
1363 The effects of continuous and fractionated doses of gamma-radiation on the survival and fertility of Sitophilus granarius (Calandra granaria L.) (Jefferies, 1962)
1364 ibid. (Jefferies and Banham, 1961)
1365 The effect of fractionated irradiation under various oxygen concentrations on the radiosensitivity of the Drosophila embryo. (Johansen, 1962)

1369 Oxygen dependence of the lethal and mutation rates induced by x-irradiation of Drosophila zygotes. (Würgler, 1960)
1370 Modification of x-ray induced embryonic mortality by different anoxia conditions before and during irradiation of uncleaved Drosophila melanogaster eggs. (Würgler, 1961)
1415 Ecological effects of ionizing radiation on organisms, communities and ecosystems. (Platt, 1963)
1447 Laboratory studies on the use of irradiated sterile males to reduce C. fatigans Wied. populations. (Ramakrishnan et al., 1962)
1481 Disinfestation of dried figs by gamma radiation. (Papadopoulou, 1963)
1482 The control of warehouse pests by gamma radiation. (Rasulov and Anastasiev, 1963)
1497 Les possibilités d'emploi des radiations dans la lutte contre les insectes. (Nardon, 1963)

I-B-7 MODIFYING FACTORS (INTENSITY. RBE. LET. TEMPERATURE. SYNERGISTS. CHEMICALS INCLUDING PROTECTIVE AGENTS. ENVIRONMENT AT IRRADIATION. Etc.)

1357 Amer, N.M., Slater, J.V. SYNERGISTIC ACTION OF X-IRRADIATION AND ELEVATED TEMPERATURES ON DEVELOPMENT. p.144-6 in "Biology and Medicine. Semi-annual Report, Fall 1961". UCRL-9897, California. Univ., Berkeley. Lawrence Radiation Lab. Oct. 1961.

A study was made of the effects of x-irradiation at 1200 r and incubation temperatures of 30° and 38°C on the production of abnormalities in the development of Tribolium. The observations of the effects are given graphically as the percent abnormalities occurring as a function of time following irradiation in days. The abnormalities were classified according to the degree of deformity in the elytra and the membranous wings.

1358 Amer, N.M., Slater, J.V., Tobias, C.A. ANALYSIS OF THE COMBINED INFLUENCE OF X-IRRADIATION AND ELEVATED TEMPERATURES ON DEVELOPMENT. (Abstr. E5) Rad. Res. 16 (1962) 574.

Temperature studies have revealed that Tribolium incubated at 30°C are least affected in regard to the subsequent development of wing abnormalities. This kind of anomalous development produced by X-irradiation was first described by Beck. Incubation at temperatures other than 30°C significantly alters the production of abnormalities, however, and incubation at elevated temperatures has been found to produce abnormalities that are indistinguishable from those produced by whole body x-irradiation or a variety of accelerated heavy ions. The combined influence of x-irradiation and subsequent incubation at elevated temperatures was investigated. It was found that the combined effects of x-irradiation and elevated temperatures (38°C) were more than merely additive in the induction of wing abnormalities. (Controls incubated at 30°C → 1.6% total wing abnormalities; at > 30°C → 4.5%; irradiated (1200 r), then 30°C → 15.2%. Pupae, after 3 d at 38°C → 60%; after 4-5 d at 30°C, then 38°C → 38%; irradiated and kept at 30°C → only 15.2%; controls, given 1200 r, at 38°C → 68%; irradiated, then 1-2 d at 30°C → most severe; 4-5 d at 30°C, then 38°C → mildest.) Mathematical analysis of the data using factorial analysis of variance showed that the differences between the irradiated animals and the controls were highly significant, the interaction between irradiation and high temperatures being found to be also highly significant. This supports the suggestion that the combined effects of irradiation and elevated temperatures are synergistic in this system. A mathematical model is suggested. (Based on abstr.)

1359 Fritz-Niggli, H., Schinz, H.R. BIOLOGISCHE WIRKSAMKEIT VON 30-MeV-ELEKTRONEN IN ABHÄNGIGKEIT VON DER GEWEBETIEFE UND IM VERGLEICH MIT 180-keV- UND 31-MeV-PHOTONEN. I. LETALITÄTSTEST AN EINSTÜNDIGEN Drosophilaembryonen. (Biological effectiveness of 30-MeV electrons in dependence on the tissue depth and in comparison with 180-keV and 31-MeV photons. I. Lethality test on one-hour Drosophila embryos.) Strahlentherapie 115 (1961) 379-93. (In German).

Equal ionization doses (ρ-measurement values) of 30 MeV electrons act the same, both qualitatively and quantitatively on 1 h ± 10 min embryos of D. melanogaster at different depths in the plexiglass phantom (0, 1.25, 5.25, 8.25, 10.25, and 12.25 cm). The dose effect curves (dose in rad noted) of 180 keV photons, 31 MeV photons, and 30 MeV electrons coincide. The relative biological effectiveness (RBE) is therefore I, and the number in rad is the same as the number in rem. If the measurement values are ρ noted in the action curves of 180 keV photons, 31 MeV photons, and 30 MeV electrons draw apart somewhat. The chosen values of the factor k, with which ρ is converted into rads, possess therefore probably a realistic value. 1-h Drosophila embryos register neither a difference in the linear ionization density nor the difference in the continuous application (180 keV photons) and the discontinuous megavolt radiation, which per second delivers 50 electron flashes in a period of 10 μs. This independency of the ray effects in the 1-h Drosophila to the ionization density explains the concordance of the biological and physical transition curves of 30 MeV electrons. (Auth)

1360 Fritz-Niggli, H., Schinz, H.R. BIOLOGISCHE WIRKSAMKEIT VON 30-MeV-ELEKTRONEN IN ABHÄNGIGKEIT VON DER GEWEBETIEFE UND IM VERGLEICH MIT 180-keV- UND 31-MeV-PHOTONEN. II. LETALITÄTSTEST AN VIERSTÜNDIGEN Drosophilaembryonen. (Biological effectiveness of 30-MeV electrons depending on tissue depth and in comparison with 180-keV and 31-MeV photons. II. Lethality tests on four-hour old Drosophila embryos) Strahlentherapie 118 (1962) 503-17 (In German).

It was found that 4 h (±10 min) old embryos of wild strains of Drosophila which are identical in their phenotype have different radiation sensitivity. The 30-MeV-electrons were significantly less effective biologically than 180-keV-photons for 4 h (±10 min) old embryos. The RBE was 0.7. The 31-MeV-photons were more effective than 30-MeV-electrons, but less effective than 180-keV-photons. The lesser effectiveness of the megavolt radiation is explained by its smaller ionization density in comparison with 180-keV-photons (100 ionizations/μ). The embryos register the difference between 6.3 ionizations/μ for 31-MeV-photons and 3 ionizations/μ for fast electrons. The dependence of the effect of ionization density on the stage of development of the object irradiated can be explained by the fact that the 1 h old embryos (RBE-1) are damaged by direct effects and the 4 h old embryos are damaged rather by indirect effects (irradiation products of water). The biological depth dose curve for 4 h (±10 min) old embryos is in good agreement with the physical curve. (Auth).

1361 Grosch, D.S., Clark, A.M. NITROGEN PROTECTION OF FECUNDITY AND FERTILITY IN FEMALE Habrobracon TREATED WITH X-RAYS. Nature, Lond. 190 (1961) 546-7.

Virgin females of Habrobracon juglandis (= Bracon hebetor) were irradiated. A N_2-atmosphere afforded nearly complete protection from 2500 r x-rays. A series of N_2-tests provided a family of curves which demonstrated that low egg production equivalent to that following 4500 r in air was attained between 12 350 and 13 600 r. Egg hatchability is summarized in tabulated form. Protection by the replacement of air by N_2 is apparent not only in a significantly higher hatchability after 4500 r but also in hatchability approaching control values after the 11th day. The results demonstrate that the protective effect of gas replacement anoxia is afforded to all types of cells in the polytrophic ovariole. They comprise differentiated, transitional and primitive cells. The progress of meiotic prophase, mitosis, and interphase characterizes the respective periods, with mitotic activity explaining the radiosensitive 6 - 10 d period. Limitation of protection by SH compounds to the sensitive period and its possible interpretation is discussed.

1362 Hansen, W.R. DETERMINATION OF THE RBE OF 14-MeV NEUTRONS USING 14 DAY OLD GRASSHOPPER EMBRYOS (Chortophaga viridifasciata AND Encoptolophus sordidus). TID-18723, Kansas Univ., Lawrence. Graduate School. May 1963. 65p.

The LD_{50} determined for 14-d, 15-d and 17-d Chortophaga embryos irradiated with 200 kVp x-rays was respectively 450 rad, 400 rad, and 580 rad. The mean lethal dose for 14-d, 15-d, and 17-d Encoptolophus embryos irradiated with 200 kVp x-rays was respectively 510 rad, 580 rad, and 630 rad. The LD_{50} for 14-d Chortophaga embryos irradiated with 14 MeV neutrons was 370 rad. The RBE of 14 MeV neutrons was determined to be 1.22. The mean lethal dose determined for any group of Chortophaga and Encoptolophus embryos was dependent on the stage of embryo development. The hatching time of the eggs irradiated with x-rays was delayed. The amount of delay was increased as the dose of x-rays was increased. The period of hatching was also spread over a greater length of time with increased doses of x-rays. (Auth)

1363 Jefferies, D.J. THE EFFECTS OF CONTINUOUS AND FRACTIONATED DOSES OF GAMMA-RADIATION ON THE SURVIVAL AND FERTILITY OF Sitophilus granarius (Calandra granaria L.). p.213-29 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

The investigation was aimed at examining the biological efficiency of multiple pass systems for radiation disinfestation of grain. At 16 500 rep there appears to be no loss in efficacy for any system likely to be met with in practice. Fractionation could, however, lead to inadequate control in packaged cereal commodities given low doses to prevent adult emergence. The following details of the study are of interest. Survival of all developmental stages was significantly increased by fractionation, particularly with larvae and pupae. The difference in survival afforded by continuous and fractionated treatments must be attributed to recovery during the intervals between damage. Recovery was noted with intervals of 10 min and longer, the amount of recovery and final survival being governed by the number of fractions, fractional dose, interval time, and interval temperature, but not by over-all dose rate. Rate of recovery was greatest in the first hours after irradiation, and decreased with increasing number of fractions. Irradiation is followed by a period of reduced sensitivity to subsequent treatment. Recovery was obtained in the reproductive capacity of irradiated eggs, larvae, and pupae, but not adults. Pupae showed the highest capacity for recovery of somatic and reproductive cells. Adults require the highest dose to kill and sterilize by continuous and fractionated treatment and are potentially the most dangerous state in the event of inefficient control.

1364 Jefferies, D.J., Banham, E.J. THE EFFECTS OF CONTINUOUS AND FRACTIONATED DOSES OF GAMMA RADIATION ON THE SURVIVAL AND FERTILITY OF Sitophilus granarius (Calandra granaria) L. AERE-R-3503, United Kingdom Atomic Energy Authority, Research Group. Isotope Research Div., Harwell, Berks., England. 1961. 48p.

See 1363. An increase in survival of all developmental stages was noted on fractionation of the dose, the amount of the increase being governed by the number of fractions, interval time, interval temperature and the developmental stage of the insect. Recovery was also noted in the reproductive capacities of insects irradiated as eggs, larvae and pupae but not adults. Calculations showed that the commercial dose of 16 500 rep may be given in 2 - 4 fractions over a period of 3 - 5 d without reducing its efficiency for the disinfestation of grain.

1365 Johansen, I. THE EFFECT OF FRACTIONATED IRRADIATION UNDER VARIOUS OXYGEN CONCENTRATIONS ON THE RADIOSENSITIVITY OF THE Drosophila EMBRYO. (Abstr.) p. 5 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England. 5-11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

Lethal injury to cells following ionizing radiation may be a result of a stepwise created damage. If the radiation dose is given fractionated in time intervals of the same order as the lifetime of essential radiation-induced radicals, one may be able to interfere with the reaction patterns. Results will be presented and discussed from experiments on the effect of ultra-short fractionated x-irradiation combined with various oxygen concentrations on the radiosensitivity of the 60 ± 5 min old Drosophila embryo. The x-ray dose is fractionated by means of a rotating disc, giving exposure times of 40 μsec as a lower limit. A relationship between the dose rate and the mitotic division time is discussed in view of the synchronously dividing nuclei in the young Drosophila embryo.

1366 Johansen, I., Oftedal, P., Havin, E. RADIOSENSITIVITY OF THE Drosophila EMBRYO. p. 20 in "Fourth Report from Norsk Hydro's Institute for Cancer Research for 1961 and 1962". Oslo. Norsk Hydros Institutt for Kreftforskning. 1963.

Some results were reported in 1262 and 1365. Further studies concerned the oxygen effect and pulsed radiation, and the effects of chronic versus acute treatment and of variations in oxygen effect at ages corresponding to maximum and minimum sensitivities.

1367 Slater, J.V., Tobias, C.A., Beck, J.S., Lyman, J.T., Martin, M.E., Luce, J.R. COMPARATIVE INFLUENCE OF ACCELERATED HEAVY NUCLEI ON ANOMALOUS DEVELOPMENT IN Tribolium. (Abstr.) Rad. Res. 14 (1961) 503-4.

The radiation-induced wing deformity in Tribolium confusum was studied. The dose-effect relationship with x-rays is a multi-hit type, with 50% of the insects developing abnormalities at 1375 r and 100% at 2000 r. With heavier particles, the dose-effect relationship appears to have a lower hit number and possibly becomes a single hit phenomenon with boron nuclei when their Bragg peak is in the sensitive region of the body. Boron and C nuclei were found to produce severe effects at much lower surface doses than apparent with O and Ne. These effects included fluid-filled wing blisters, and exposure and extension of the underwings at wide angles. Boron and C nuclei penetrate further than do O and Ne, and may produce these abnormalities because the organism is probably not uniformly sensitive. Interpretation is further complicated by the existence of different linear energy transfer values at the Bragg peaks of different nuclei. In the initial phases of this study it was found with α-particles that the region resulting in wing abnormalities is located near the ventral body surface at a depth of about 300 μ. Following irradiation of the pupae with various nuclei, the O_2 consumption of the developing organism was decreased. (From abstr.)

1368 Slater, J.V., Amer, N.M., Tobias, C.A. MODIFICATION OF RADIATION RESPONSE DURING EMBRYONIC DEVELOPMENT BY THE USE OF ELEVATED TEMPERATURES. (Abstr.) p. 241 in "2nd International Congress on Radiation Research, Harrogate, Yorkshire, England, 5 - 11 August 1962". London, Silver End Documentary Publications, Ltd. 1962.

The induction of anomalous wing-development in adult Tribolium by x-irradiation of newly formed pupae was first described by Beck (1961). Subsequent studies with a variety of temperatures have shown that post-irradiation incubation at 30°C results in minimal damage. Incubation at temperatures higher than 30°C was found, however, to alter the number of disturbances occurring. Post-irradiation incubation at 38°C, after subjecting pupae to as little as 50 r (250 KVp x-rays), was found to increase significantly the percentage of abnormalities produced. When test organisms were irradiated with 1200 r and placed immediately afterwards at 38°C for variable time periods, it was discovered that the combined effects of x-irradiation and high temperatures were more than merely additive, with the maximum accumulative effect being reached only after 3 d incubation at that temperature. Irradiated pupae, incubated at optimum temperatures for development (30°C) for 4 - 5 d and then exposed to 38°C for as short a period of time as 2 d prior to eclosion as adults, were still found to exhibit a considerable increase in numbers of malformations. Factorial analysis showed that the interaction between radiation and incubation at elevated temperatures was highly significant ($p = 0.01$).

1369* Würgler, F.E. DIE SAUERSTOFFABHÄNGIGKEIT DER ABTÖTUNGS- UND MUTATIONSRATE BEI RÖNTGENBESTRAHLUNG VON Drosophila-ZYGOTEN. (Oxygen dependence of the lethal and mutation rates induced by x-irradiation of Drosophila zygotes). Rev. suisse Zool. 67 (1960) 295-302. (In German).

The oxygen effect noted by Ulrich on embryonic and post-embryonic mortality following whole-body irradiation of Drosophila zygotes (Berlin wild) could also be demonstrated in dose-effect curves of F_1-zygotes of the cross "Berlin wild" X Muller 5 (Basc). Irradiation of zygotes in a N_2-atmosphere gave a linear increase in frequency of recessive sex-linked lethals with dose, when plotted semi-logarithmically. A mathematical analysis of the data shows that embryonic and post-embryonic mortality and also mutation rates could be lowered by half if irradiation occurs under conditions of anoxia.

1370 Würgler, F.E. MODIFICATION OF X-RAY INDUCED EMBRYONIC MORTALITY BY DIFFERENT ANOXIA CONDITIONS BEFORE AND DURING IRRADIATION OF UNCLEAVED Drosophila melanogaster EGGS. Drosophila Inf. Serv. 35 (1961) 102-3.

See also:

1080 The effect of culture environment on the susceptibility of the grain weevil Sitophilus granarius L. to gamma radiation. (Martin et al., 1962)
1242 Some effects of irradiation on Cochliomyia hominivorax. (Dixon, 1962)
1243 Response of Tribolium confusum to radiations and other stresses. (Ducoff and Bosma, 1963)
1254 The effect of gamma radiation on silkworm eggs. (Henneberry and Sullivan, 1962)
1255 Effect of gamma-radiation on eggs of the silkworm. (Henneberry and Sullivan, 1963)
1260 Studies on the breeding method taking advantage of γ-rays in the silkworm. (Japan. Sericultural Experiment Station, Tokyo, 1963)
1262 Studies on the radiation sensitivity of Drosophila embryos. (Johansen, 1962)
1272 Sensibilité aux rayons X de la durée de développement des oeufs de Bombyx mori lorsque l'irradiation est effectuée quelques heures après le début de l'incubation. (Legay and Teulade, 1962)
1285 Radiosensitivity of various stages of Callosobruchus chinensis L. (Quraishi and Metin, 1963)
1286 Studies on the effect of beta-radiations on insects. II. The effect of beta-radiations (irradiation of full-grown caterpillars and freshly-formed pupae) on the life-history of Corcyra cephalonica Stainton. (Rattan Lal et al., 1960)
1288 Effect of Co^{60} gamma rays on the small cutworm. (Sidorova, 1963)
1292 Studies on heavily ionizing particles - HILAC studies. (Tobias, 1963)
1294 Experimental analysis of a linear dose effect curve resulting from x-irradiation of Drosophila eggs. (Würgler, 1962)
1297 Effects of desiccation of Drosophila females on the frequencies of irradiation induced embryonic abnormalities. (Annan and Reitan, 1961)
1301 Effects of x-irradiation upon cell population and morphogenesis in the wing of Tribolium confusum. (Beck, 1962)
1303 Temperature dependence of wing abnormality in Tribolium confusum. (Slater et al., 1963)
1309 Partial-body radiations of queen honey bees. (Lee, 1963)
1323 Radiobiologic studies with Drosophila. (Baxter, 1963)

1341 Response of Tribolium larvae to x-irradiation. (Ducoff and Walburg, 1960)
1344 Lethal effects of X-rays on the housefly, Musca domestica L. (Grasso et al., 1962)
1345 Lethal effects of X-rays on Musca domestica L. (Grasso et al., 1963)
1355 The response of blood-fed Aëdes aegypti to gamma radiation. (Stahler and Terzian, 1963)
1384 Effects of temperature and x-ray irradiation on intrinsic growth rate in populations of Drosophila pseudoobscura. (Tantawy, 1963)

I-B-8 SPECIES, STRAINS, LINES (COMPARATIVE STUDIES)

1371* Bruel, W. E. van den, Bollaerts, D. RESISTANCE OF Sitophilus granarius AND Sitophilus oryza AT DIFFERENT STAGES OF THEIR DEVELOPMENT TO γ-IRRADIATION FROM COBALT-60. Bull. Inst. agron. Gembloux Extra Vol. 2 (1960) 883-905. (In French).

In grains of wheat, 1000 rad of γ-rays destroyed 99% of the eggs (2 d old) of S. oryza, but with eggs of S. granarius 2500 rad was required for 98% destruction. S. granarius showed a greater resistance to irradiation at all stages of development than S. oryza, but the differences in resistance decreased at later stages. With nymphs and young adults of S. oryza 3500 rad prevented development, but 5000 rad was required for the same stages of S. granarius. The γ-rays had some action in sterilizing adults at approximately 2500 rad, with S. oryza being somewhat less resistant than S. granarius. In both species, 5000 rad or more was required for complete sterilizing of adults. In some tests on adults U was used as the source of the γ-rays, and 10 000 rad killed all insects of both species. (CA 56: 1962, 5081c)

1372 Erdman, H. E. X-RAY EFFECTS ON SINGLE AND MIXED SPECIES POPULATIONS OF Tribolium confusum AND Tribolium castaneum (COLEOPTERA: TENEBRIONIDA). HW-SA-2686, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 24 July 1962, 8p.

A difference in radiosensitivity of T. confusum and T. castaneum was found following exposure to doses of 2 to 6 kr x-radiation. Reproductive capacity and individual weights were used as criteria of radiosensitivity. Populations of flour beetles were cultured as single or mixed species. Sterility in both species and shortened life-spans in T. confusum occurred at 6000 r. All other groups exhibited increased reproductive abilities with time and no significant mortalities. Controls in single or mixed populations produced comparable numbers of F_1 adults. In irradiated single populations T. castaneum was significantly more productive, thus indicating greater resistance to x-radiation. Corroborative evidence was obtained from mixed populations, in which T. castaneum constituted 73, 90 and 94% of individuals, from controls 2000 and 4000 r, respectively. At 0 and 2000 r T. castaneum produced more progeny in mixed species cultures than alone, whereas the converse was true for T. confusum. At 4000 r, these traits were absent in both groups and T. confusum produced no progeny during the first 2 weeks. Within each species F_1 production was affected to the same degree in single and mixed cultures at a given radiation dose. A paper of the same title was presented at the 2nd International Congress of Radiation Research, held at Harrogate, Yorkshire, England, Aug. 5-11, 1962.

1373 Erdman, H. E. THE DIFFERENTIAL SENSITIVITY OF FLOUR BEETLES, Tribolium confusum AND T. castaneum TO X-RAY ALTERATION OF REPRODUCTIVE ABILITIES, INDUCED DOMINANT LETHALS, BIOMASS, AND SURVIVAL. J. exp. Zool. 153 (1963) 141-7.

Some aspects of growth are reported for x-rayed populations cultured as single- or mixed-species. Irradiation with 250-kV x-rays was carried out at 1 kr/min to total doses of 2, 4, or 6 kr. Reproductive abilities, measured as the mean number of F_1 adults per female, for single-species populations of T. castaneum given 2 h approached control values after 1 month, whereas those of T. confusum persisted below controls. Four kr was almost sterilizing, over 90 and 99% sterilizing respectively for T. castaneum and T. confusum, while 6-kr doses induced complete sterility in both species. Dominant lethals induced by 2kr were approximately twice as abundant in T. confusum as in T. castaneum. Increased fertility with time was considered evidence that undifferentiated gametes were more radioresistant than mature ones. Selective elimination of a flour beetle species (T. confusum) in coexistence was indicated at exposures > 4 kr but < 6 kr. Interspecies antagonism and 2-kr irradiation, as an environmental stress factor, appeared additive in adversely influencing the reproductive ability of T. confusum. The dose-response curves for reproduction were linear up to 4 kr except for T. confusum. After 4 kr the dose-response curves departed from linearity for both species. Biomass (standard dry wt) of F_1 adults decreased with increasing dose; however, the weight of individuals was not altered. Parental mortality was not affected at 2 and 4 kr; 94 - 100% were alive at 10 weeks. In the 6-kr group, 75 and 58% of T. confusum were alive in the single- and mixed-species populations, respectively, indicating that irradiation and coexistence reduced survival. Thus, these 2 organisms of similar biology differed radiologically, as seen by the overall greater radioresistance of T. castaneum compared with that of T. confusum. The one more pair of chromosomes in T. castaneum probably does not satisfy a genetic interpretation of radioinduced damage, but physiologic and cytogenetic factors may be responsible. (NSA 18: 1964, 9864). A report, under the same title, was published as HW-SA-2950, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 12 Mar. 1963, 18p.

1374 Lüers, H. REACTIONS TO X-RAYS OF A NORMAL AND A HCN-UNSUSCEPTIBLE STOCK OF Drosophila melanogaster. (Abstr.) Int. J. Rad. Biol. 6, 4 (1963) 380.

Two stocks have been compared in respect to some reactions of the males to x-rays; the normal stock Berlin wild (+B), which is highly susceptible to HCN, and a 2nd (R II), derived from the former by selection, which is rather unsusceptible to HCN. Simultaneously the latter stock is resistant to DDT. The selection work had been done in respect of DDT-resistance. After giving HCN-gas the LT_{50} values (in minutes) for the susceptible stock are about 8·0 for the males, and 9·2 for the females; the corresponding values for the unsusceptible stock are 12·0 and 13·3. After these times of exposure there is 100% mortality in both sexes in the first stock. The males of these stocks have been irradiated with doses of 1·5; 3·0 and 4·5 kr (100 kV; 8 mA; 1·7 mm Al; 430 r/min) in air and individually and repeatedly crossed with one Basc female each in intervals of 3 d until the 3rd brood. In the F_1 two characters have been studied; (a) the percentages of fertile cultures, (b) the numbers of progeny per fertile culture. It could be seen, that at all dosages and in all broods the males of the R II stock give higher values. In the (a) experiments the differences rise with rising dose in all broods showing P values $< 10^{-10}$ for 4·5 kr. In the (b) experiments the absolute differences diminish with rising doses, especially in the 3rd brood with the lowest fertility. In the F_2 giving the numbers of sex-linked recessive lethals no differences could be seen between the 2 stocks at the 3 dosages in the 1st brood. But in the 2nd brood (mainly spermatids during irradiation) the percentages of lethals are smaller in the R II stock at all dosages, the differences growing with rising dose. In the 3rd brood no sharp decrease in the rate of mutations can be seen in the R II stock giving somewhat higher rates than the +B stock. In the 3·0 kr experiment, for instance, the relative values of the mutation-rates in the two stocks in the 3 broods are: +B = 1·0; 1·2; 0·8 and R II = 1·0; 1·0; 1·1. In respect to the different brood patterns of the 2 stocks reference is made to the results of other authors, especially to the experiments of Sobels, who found a sharp rise of mutation-rates in the second brood (spermatids) of a normal stock, when the flies had been irradiated in an HCN-atmosphere. (Essentially abstr.)

See also:

773 The use of ionizing radiation in the preservation of cereal products. (Dal Monte, 1959)
778 Effects of irradiating single and mixed species of beetles, (Erdman, 1961)
779 X-ray tolerance of two related species of beetles. (Erdman, 1962)
1222 Effects of radiations on insects. (LaChance, 1962)
1226 Effects of gamma radiation on various stages of three fruit fly species. (Balock et al., 1963)
1228 The susceptibility of the confused flour beetle (Tribolium confusum Duv.) to gamma radiation. (Banham, 1962)
1229 Radiation effects on reproduction in plateaued and unselected strains of Tribolium castaneum. (Bartlett and Bell, 1961)
1230 The effect of irradiation on reproduction in two strains of Tribolium castaneum Herbst. (Bartlett and Bell, 1962)
1246 X-ray effects on different life stages of two flour beetle species (Tribolium confusum, Tribolium castaneum). (Erdman, 1962)
1247 Comparative x-ray sensitivity of Tribolium confusum and T. castaneum (Coleoptera: Tenebrionidae) at different developmental stages during their lifecycle. (Erdman, 1962)
1280 Studies on the effect of ionizing radiation on the development of insects. (Palii and Iirkovskii, 1962)
1320 Radiation effects on genetic systems. (Oster, 1961)
1323 Radiobiologic studies with Drosophila. (Baxter, 1963)
1338 Relationship between Y-chromosome and longevity in Drosophila melanogaster, especially in term of the radiation effect. (Tobari and Moriwaki, 1961)
1340 The effects of gamma-ray irradiation on certain species of stored-product insects. (Dennis, 1961)
1343 Effects of gamma radiation on Culex fatigans egg rafts. (Ghosh et al., 1961)
1347 Preliminary studies on irradiation of some common stored-grain insects in Pakistan. (Huque, 1963)
1349 Comparisons of inbred and random bred larval survival to 1200 r. (Lovellette and Ratty, 1962)

1356 Effects of gamma radiation on three species of Philippine insect pests. (Viado and Manoto, 1963)
1481 Disinfestation of dried figs by gamma radiation. (Papadopoulou, 1963)
1493 Irradiation of fruits and vegetables in a mobile cobalt 60 unit. (Harvey, 1963)

I-C Radiation Effects on Insect Populations

I-C-1 MALE COMPETITION

1375 Dame, D.A., Schmidt, C.H. THE IMPORTANCE OF COMPETITIVENESS OF RADIOSTERILIZED MALES IN MOSQUITO-CONTROL PROGRAMS. p.165-8 in "Proceedings of the 49th Annual Meeting of the New Jersey Mosquito Extermination Association, 1962".

The failure of 2 mosquito (Anopheles quadrimaculatus) eradication trials was analyzed for contributing factors such as sexual vigour, competitiveness, flooding ratios, etc. Differences in pupal mortality and adult viability in Aëdes aegypti depend on age of pupae at irradiation. Data are tabulated on effect of exposure to γ-radiation in the pupal stage on adult emergence and viability. Effect of radiosterilization on competitiveness was examined in the two species. Pupal age at irradiation also markedly affects post-irradiation competitiveness of quadrimaculatus. In order to check on the mating of laboratory-reared males with wild females sperm of quadrimaculatus were labelled by exposing larvae to P^{32}. Such adults are not harmed by their ingested radioactivity and mate normally under laboratory conditions. Labelled sperm in the spermathecae readily identify females after mating with labelled, laboratory-reared males. The technique should allow such inseminated females to be identified in the field.

1376 Henneberry, T.J., McGovern, W.L. EFFECTS OF GAMMA RADIATION ON MATING COMPETITIVENESS AND BEHAVIOUR OF Drosophila melanogaster MALES. J. econ. Ent. 56, 6 (1963) 739-41.

Immediately after treatment 3- to 4-d old males of D. melanogaster Meigen exposed to 16 kr of γ-radiation did not mate as readily or as many times with virgin females as untreated males or males exposed to 8 kr. However, males exposed to 16 kr recovered within 24 h and normal mating frequency and behaviour occurred. When male flies exposed to 16 kr were held for 24 h before mating, the number of matings per day was not affected and there was very little effect on mating competitiveness of these males as compared with untreated males. (Auth. summary)

1377 Strømnaes, Ø., Kvelland, I. SEXUAL ACTIVITY OF Drosophila melanogaster MALES. Hereditas 48 (1962) 442-70.

The experiments were divided into 3 groups (0, 24, 72) according to the (approximate) age in hours of the males at the time of irradiation. They were mated to several virgin females during two 12-h mating periods interrupted by a 12-h celibacy period. All matings were observed, the inseminated females isolated, and the offspring counted. Among very young males (during first 12 h after emergence from pupal case) a considerable portion copulate before being able to create offspring. Sexual activity is higher in the 1st hour after males are transferred from isolation to females (true for all males except group 0). Activity is almost the same during both mating periods for groups 24 and 72. The frequency of sterile matings seems to increase with the number of matings a male is capable of performing during a 12-h period. The average brood size seems to decrease with increased sexual activity of the male. Males with high activity have, in their 1st mating after a celibacy period, a much higher brood than males with low activity.

1378 Weidhaas, D.E., Schmidt, C.H., MATING ABILITY OF MALE MOSQUITOES, Aëdes aegypti (L.), STERILIZED CHEMICALLY OR BY GAMMA RADIATION. Mosquito News 23, 1 (1963) 32-4.

The effectiveness of males sterilized by apholate (2, 2, 4, 4, 6, 6-hexahydro-2, 2, 4, 4, 6, 6-hexakis (1-aziridinyl)-1, 3, 5, 2, 4, 6-triazatriphosphorine) and of males sterilized by γ-rays is compared for reduction in reproductive potential among caged populations of the yellow fever mosquito, Aëdes aegypti L. For irradiation, groups of male pupae > 24 h old, were given 8000 r and 10 000 r γ-rays (Co^{60}-source) at ~690 r/min. For chemosterilant treatment, groups of unirradiated males were fed for the first 3 to 4 d after emergence on 1% apholate in a 20% aqueous honey solution. Subsequent crossing tests and their results are described. Chemosterilants appear to offer an effective method of sterilization without damaging the mating ability of A. aegypti, but dosages of radiation sufficient for sterilization of males prevent them from competing fully with normal males. Further studies may develop a method of administering radiation at a time in the life cycle which will not decrease male competitive ability.

See also:

763 Radiation-induced sterility in the insect Rhodnius prolixus. (Baldwin and Shaver, 1963)
804 Quelques résultats supplémentaires concernant l'influence des rayons gamma sur les chrysalides et les oeufs de la teigne de la farine "Ephestia kuehniella Z." (Pelerents, 1963)
807 Some effects of gamma radiation on the reproductive potential of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962)
1284 Influence of gamma radiation on the development and fertility of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962)
1427 Effects of ionizing radiation on insects and other arthropods. (Stone, 1963)
1445 Mass production of sterilized male Aëdes aegypti. (Fay et al., 1963)
1455 Sterilization of the Mediterranean fruit fly and its application to fly eradication. (Katiyar and Valerio, 1963)
1456 The application of nuclear energy to agriculture. (Moh, 1963)
1476 On the role of lethal mutants in the control of populations. (Borstel and Buzzati-Traverso, 1962)

I-C-2 BEHAVIOUR

1379 Hungate, F.P. RADIATION AVOIDANCE RESPONSES IN ANIMALS. (Abstr. A1A782) p.3 in "Research and Development in Progress. Biology and Medicine. Issue No.2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

A variety of animal species were tested. Exposure to 500 r of γ-rays has failed to identify an avoidance response in Drosophila. Attempts to selectively breed a strain showing an avoidance response have as yet been unsuccessful, apparently because of an inadequate selection against those animals unable to detect the radiation.

1380 Хрущев, В.Г., Правдина, Г.М., Даренская, Н.Г. ПОВЕДЕНИЕ ПЛОДОВОЙ МУШКИ (Drosophila melanogaster) ВО ВРЕМЯ ЛУЧЕВОГО ВОЗДЕЙСТВИЯ. Радиобиология 2, 2 (1962) 272-9.

Khrushchev, V.G., Pravdina, G.M., Darenskaya, N.G. BEHAVIOUR OF THE FRUIT FLY (Drosophila melanogaster) DURING IRRADIATION. Radiobiology 2, 2 (1962) 150-60. AEC-tr-5429, March 1963. Translation from Radiobiologiya 2, 2 (1962) 272-9.

A marked drop was observed in the number of eggs laid by irradiated females. A series of experiments in which the disposition and combination of the radiation sources were varied showed that under existing conditions the females avoided ovipositing in the zone of irradiation. Co^{60} and P^{32} (2 - 0.2 mc/cm) were used. The threshold of sensitivity to β-radiation from P^{32} did not exceed 0.02 r/sec. The need is stressed for taking into account the character of the response reaction to irradiation when comparing the radiosensitivity of different species.

1381 Pavan, C. A COMPARATIVE STUDY BETWEEN NATURAL LETHALS AND LETHALS INDUCED BY RADIATION IN POPULATIONS OF Drosophila willistoni. (Abstr. B1D583) p.49 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

Two types of experiments were set up to compare the behaviour of flies carrying radiation-induced and spontaneous lethals. In one experiment, flies heterozygous for 2 lethals, one natural and one induced by radiation, were released among the populations of 2 islands in the bay of Angra dos Reis in Brazil. On July 26 populations cages were set up, 3 consisting of N1R1, N1R2, N2R1 and N2R2, and 3 of N3R3, N3R4, N4R3 and N4R4. About 3000 crosses were made with the marked strains (i.e. 500 with flies from each cage). A detailed report is pending. (Based on abstr.)

1382 Stark, R.W. THE EFFECTS OF GAMMA RADIATION ON THE BIOLOGY AND BEHAVIOUR OF FOREST INSECTS AND THE POSSIBILITY OF THEIR CONTROL BY MEANS OF IRRADIATION TECHNIQUES. (Abstr. K1C139) p.165 in "Research and Development in Progress. Biology and Medicine. Issue No.1". TID-4200, Division of Technical Information, AEC. July 1963.

The project was initiated in 1963. The objectives are to investigate the feasibility of irradiation techniques for control of forest insects, particularly a bark beetle Ips confusum (LeConte) and a sawfly (defoliator)

Neodiprion fulviceps complex. A Model 2, Co^{60} irradiator (1000 c) calibrated at 1000 r/3 min of exposure was used to irradiate various stages of the sawfly and adults of the bark beetle at dosages ranging from 5000 to 140 000 r. Irradiation of feeding larvae, ultimate instar larvae, and prepupal larvae of the sawfly at dosages of > 1000 r prevented successful development. Irradiation of pupae stimulated emergence, and significant mortality did not occur at < 100 000 r. Behavioural processes of larvae, particularly feeding and cocoon formation, were markedly affected. Sterilization effects cannot be determined until spring, 1964. Sterilization of both males and females of the adult bark beetle apparently occurs at low radiation levels (< 10 000 r). Gallery patterns, oviposition, mating behaviour and longevity seem to be little affected at this dosage level. Sterilization to aid in control appears to be a distinct possibility if used in conjunction with natural attractants. (From abstr.)

See also:

812 Study on houseflies sterilized with x-rays. (Saccà, 1961)
1209 Study on the evolution of social parasitism in the ant. Attempts of genetic interpretation and plans for experimental analysis. (Jucci, 1963)
1376 Effects of gamma radiation on mating competitiveness and behaviour of Drosophila melanogaster males. (Henneberry and McGovern, 1963)
1377 Sexual activity of Drosophila melanogaster males. (Strømnaes and Kvelland, I.)
1471 Sterilization by gamma radiation for the control of the navel orangeworm Paramyelois transitella (Walker) (Lepidoptera: Phycitidae). (Husseiny, 1963)

I-C-3 POPULATION DYNAMICS

1383 Marques, E.K., Maciel, C.M.P. SOME COMPONENTS OF ADAPTIVE VALUES OF HETEROZYGOUS Drosophila willistoni FROM IRRADIATED NATURAL POPULATIONS. Experimentia 17 (1961) 404-5. (In English).

The analysis of some adaptive components (percentage of hatched eggs, viability, and sterility) in an isolated natural population of D. willistoni shows, after irradiation with Co^{60}, reduced adaptive values during several generations after irradiation with progressive recuperation to the control level in successive generations. However, this population for 15 generations does not attain the percentage of hatched eggs of untreated populations. (Auth)

1384 Tantawy, A.O. EFFECTS OF TEMPERATURE AND X-RAY IRRADIATION ON INTRINSIC GROWTH RATE IN POPULATIONS OF Drosophila pseudoobscura. Genetica 34 (1963) 34-45.

An experiment was designed using populations of D. pseudoobscura with different gene arrangements on the third chromosome, to study the effects of various temperatures and different dosages of radiation on the innate capacity for increase. The innate capacity for increase was found to increase with temperature and decrease with higher radiation dosages. The mean generation length showed a decline with both treatments, with a greater decrease in the former treatments. Net reproductive rate showed a decrease in both cases while the finite rate of increase (λ) showed an increase in the temperature experiment and a decrease in the radiation experiment. Percentage contribution of each age group to the rate of multiplication per generation depended on temperature and dosages of radiation as well as the genetic background of the population. (Auth.)

1385 Stone, W.S. RESEARCH IN GENETICS. (Abstr. B1D255) p.46 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

This research includes: 1) Population and evolutionary studies of Drosophila and 2) Direct and indirect effects of radiation and their modifications using dominant lethals, recessive lethals and translocations as a measure of genetic damage. The first part is concerned with the analysis of genetic population structure including concealed variability in the form of detrimental, sterile and lethal factors. This is investigated in small populations, large thin populations and in large dense populations. Further extensive tests of viability, fertility and fecundity utilizing other island populations where migration is minimum will provide a better understanding of the genetic structure of populations in relation to their size, distribution and isolation. Studies are being made with D. pseudoobscura, D. ananassae, D. melanogaster and others. Direct and indirect radiation effects are being studied with Drosophila and microorganisms. Experiments measure the relation between radiation damage and environmental variables such as temperature, gaseous environment of the organisms (argon, air, oxygen, helium, methane, carbon monoxide, nitric oxide, propane, etc.) under normal or increased gas pressure. We are studying these effects on both male and female D. melanogaster (recessive lethals) and in D. virilis (dominant lethals and translocations) over the full cycle of spermatogenesis and some stages of oögenesis. The amount of damage from the same dose of radiation may be modified by a factor of 4, therefore they provide understanding of the relationships between radiation and organism.

1386 Sankaranarayanan, K. FITNESS OF IRRADIATED POPULATIONS OF Drosophila melanogaster. (Abstr. 5.58) p. 75 in "Genetics of Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Males in experimental populations of D. melanogaster were treated with acute doses of x-rays (2000 r, 4000 r, 6000 r and 7000 r) and the effects of irradiation on population fitness were studied under conditions of relaxed selection, the relaxation being obtained mainly, by minimizing larval competition. In one population, males received an initial dose of 7000 r units and no further irradiation in subsequent generations. At other dose levels, there were populations where the males received x-irradiation (1) at generation O only and (2) at generation O and in every subsequent generation. From the latter, subpopulations were derived where irradiation was stopped after 5, 10 and 15 generations. The components of fitness investigated are (1) hatchability, (2) viability from the larval to the adult stage, and (3) viability from the egg to the adult stage. An important finding that confirms the results of earlier investigators is the observation that the radiation induced mortality (dominant lethal effect) is mainly (but not exclusively) at the egg stage. A second finding is the surprisingly rapid recovery to the control level in hatchability and viability rate following the cessation of irradiation. A detailed analysis of the second chromosomes is in progress to get an estimate of the radiation-induced genetic load and to gain an insight as to how much of the genetic load is adaptively incorporated into the gene pool of the population.

I-C-4 GENETIC CHANGES

1387 Almeida Toledo, S.F. VERIFICACAO PRELIMINAR SOBRE A FREQUENCIA DE GENS LETAIS EM POPULACOES DE Drosophila willistoni QUE VIVEM EM REGIOES DE ALTO NIVEL DE RADIACAO. (Preliminary study on the frequency of lethal genes in populations of Drosophila willistoni living in regions with a high level of background radiation). An. Acad. brasil. Ciênc. 35, 1 (1963) 103-7. (In Portuguese, with English summary).

D. willistoni were collected from regions with a radiation background 50 times above the normal level. The techniques used were those of Pavan et al. (Genetics 36: 1951, 13). The flies were then crossed with two marked stocks, and the homozygous individuals obtained in F_1 analysed. Results are tabulated. No radiation effects could be detected by analysis under the sampling and testing conditions set out in the paper.

1388 Blaylock, B.G. CHROMOSOMAL ABERRATIONS IN A NATURAL POPULATION OF Chironomus tentans EXPOSED TO CHRONIC LOW-LEVEL ENVIRONMENTAL RADIATION. Thesis. Tennessee. Univ. Knoxville. 1963. 89p.

The salivary gland chromosomes of Chironomus tentans larvae collected from White Oak Creek, an area contaminated by radioactive waste from the Oak Ridge National Laboratory, and from six uncontaminated areas were examined for chromosomal aberrations. White Oak Creek populations were exposed to 230 rads per year or about 1000 times background. Chromosomal maps were constructed to make a general comparison of the banding pattern of the salivary chromosomes of the C. tentans in the East Tennessee area with those of Canada and Europe. These maps were used as a reference in scoring aberrations. Fifteen different chromosomal aberrations were found in 365 larvae taken from the irradiated population as compared with 5 different aberrations observed in 356 larvae from 6 control populations, but the mean number of aberrations per larva did not differ in any of the populations. The quantitative amount of heterozygosity was essentially the same in the irradiated and the control population, but there were three times the variety of chromosomal aberrations found in the irradiated area. From this evidence it was concluded that chronic low-level irradiation from radioactive waste was increasing the variability of chromosomal aberrations without significantly increasing the frequency. Five different inversions were found in both the irradiated and control populations; three inversions - 1Ra, 2Lab, and 3Ra - were found at a relatively high frequency and were used in testing the seasonal and geographic distribution. In the White Oak Creek population the frequencies of the heterozygous inversions did not change significantly for a three year period from 1960 to 1962. Also, no changes that could be attributed to seasonal change were detected in the frequencies of these inversions from June through December of 1961 and September through December of 1962. There was no significant difference in the frequencies of these same heterozygous inversions between three local geographic populations of C. tentans. It was concluded that the 3 inversions which occurred at the highest frequencies are endemic to the population of East Tennessee and have been established in the population for a long time. The frequencies of the standard arrangement, the heterozygous inversion, and the homozygous inversion of 1Ra were significantly different from the expected frequencies as predicted by the Hardy-Weinberg Law. A deficiency of inversion heterozygotes was found which is contrary to the theory of balanced chromosomal polymorphism; but is consistent with a model proposed by Levene, where under certain assumptions genetic equilibrium can be obtained without the heterozygote being superior. The results show that chromosomal polymorphism can be maintained in a natural population without superiority of the heterozygote individuals. (Diss. Abstr. 24: 1964, 3022)

1389 Blaylock, B.G., Nelson, D.J., Auerbach, S.I., Griffith, N.A. POPULATION GENETICS AND RADIATION EFFECTS STUDIES ON *Chironomus tentans.* Health Physics Division Annual Progress Report for Period Ending June 30, 1963. p. 112-4 in ORNL-3492, Oak Ridge National Lab., Tenn. 30 Sep. 1963.

The salivary gland chromosomes of *C. tentans* larvae collected from White Oak Creek and from 6 uncontaminated areas were examined for chromosomal aberrations. White Oak Creek populations were exposed to a dose rate calculated as 230 rad/year, or about 1000 times background. Fifteen different chromosomal aberrations were found in 365 larvae taken from the irradiated population as compared with 5 different aberrations observed in 356 larvae from 6 control populations, but the mean number of aberrations per larva did not differ in any of the populations. The quantitative amount of heterozygosity was essentially the same in the irradiated and the control population, but there was three times the variety of chromosomal aberrations found in the irradiated area. From this evidence it was concluded that chronic low-level irradiation from radioactive waste was increasing the variability of chromosomal aberrations without significantly increasing the frequency.

1390 Carfagna, M., Solima, A., De Capoa, A. NOTA PRELIMINARE SULLE VARIAZIONI DI ALCUNI FATTORI DI IDONEITÀ (FITNESS) IN POPOLAZIONI DI *Drosophila melanogaster* PERIODICAMENTE IRRADIATE. (Preliminary note on the variation of a fitness factor in a periodically irradiated population of *Drosophila melanogaster.*) *Atti Ass. genet. ital.* *6* (1961) 277-84. (In Italian, with English summary).

Two populations of *D. melanogaster* were irradiated periodically with small doses of x-rays (100 r and 500 r). These, and two controls, were maintained at 19±1°C. On the 150th and 225th day the hatchability and fertility were assayed on egg samples obtained from individuals which had not been irradiated directly, taken from each population. The relative data indicate a percentage diminution of these 2 fitness factors in the populations irradiated with 500 r and, to a smaller extent, in those irradiated with 100 r. The diminution in fitness is interpreted as being due to the accumulation of lethal genes induced by the irradiation. At 25-d intervals the numerical levels were determined, altogether 17 times. The totals obtained are significantly higher (with the χ^2 test) in the 500-r- than in the 100-r-population and in controls. The heterogeneity test was, however, positive. If confirmed, these observations could be interpreted as being due to a greater adaptability in the irradiated populations in a selective environment. (From auth. summary).

1391 Carson, H.L. TRANSITORY INCREASE IN GENETIC LOAD IN IRRADIATED LABORATORY POPULATIONS OF *Drosophila melanogaster.* (Abstr. 5.57) p. 74 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Four replicate populations (2 control and 2 experimental) of *se ss e^s k ro* stock were maintained for 3 years in vial populations in which food, space and change schedule were rigidly controlled. Populations produced by this design are small (not more than 200 adults) and are equilibrated under strong natural selection. Population size and production were measured weekly. The experimental populations received radiation treatment; the dose was given over a period of 2 years and totalled 65 000 r units of x-ray. Rate of administration was 1000 r/week with 3 periods of 10, 10, and 20 successive weeks during which radiation was suspended. No radiation was given in the final year. Genetic loads carried by each population were measured three times during the final year. Random lots of eggs from each population were collected, counted and then adults were reared from these eggs under ideal conditions. Yields of adults from the irradiated populations were significantly below those of the controls at the first measurement. This indicates that these populations were carrying genetic loads due to the history of radiation. These differences, however, were absent after one year, indicating that the loads due to radiation had disappeared. This effect is ascribed to the efficiency with which natural selection removes new deleterious mutants from small populations. At the termination of the experiment, population sizes of the experimentals did not differ significantly from the controls.

1392 Chung, C.S. RELATIVE GENETIC LOADS DUE TO LETHAL AND DETRIMENTAL GENES IN IRRADIATED POPULATIONS OF *Drosophila melanogaster.* *Genetics* *47*, 11 (1962) 1489-1504.

The effect of irradiation on the relative genetic loads due to detrimental and lethal genes expressed by inbreeding was studied by extracting 267 second chromosomes of *D. melanogaster* and by examining their effects on viability in homozygous and heterozygous conditions for one nonirradiated and 6 irradiated populations. These irradiated groups had been maintained in the laboratory for several years after cessation of the irradiation. No consistent relationship of these loads to the radiation history of the different population was found. The data indicated that the irradiated stocks are nearly at equilibrium for both detrimental (D) and lethal (L) loads. The overall mean ratio of D to L was estimated as .58. Slight increase of D but constant L with crowding condition of culture suggested that the D to L ratio may be underestimated under uncrowded laboratory conditions. The inbred genetic load effected through sterility has been expressed in terms of sterile equivalent with two components of partial and complete sterility. Over both sexes the two components were found to be equally important to their harmful effects. Approximately one fourth of the total inbred load manifested through lowered viability and sterility is contributed by sterility factors. The second chromosomes of the irradiated populations in heterozygous arrangement with cn bw^D or Cy O marker chromosomes caused significantly reduced viability below the similar combinations of nonirradiated population. This increased heterozygous load due to irradiation was in the magnitude of 0.0225±0.0084. Implication of this finding relative to degree of dominance of detrimental genes is discussed. (Auth.)

1393 Cordeiro, A.R. CHROMOSOMAL POLYMORPHISM DECREASE DUE TO γ-RADIATION ON NATURAL POPULATIONS OF *Drosophila willistoni.* *Experientia,* *17* (1961) 405-6. (In English).

In an isolated natural population of *D. willistoni* more than 70 000 γ-irradiated flies were released within 7 months. A significant decrease of the mean inversion frequency per individual was established. Some inversions in the second chromosome and IIIC, IIID, IIIE, and IIIF were even rarer than in the non-irradiated natural control populations even 14 months (35 generations) after the last release. In the irradiated population two new inversions were found (one in the X and one in the third chromosome). (Auth)

1394 Cordeiro, A.R., Reguly, M.K., Centeno, A.J. RESTORATION, WITHOUT SELECTION, OF BALANCED GENETIC LOAD BY RADIATION OF *Drosophila* INBRED STRAINS. (Abstr. 5.62) p. 76 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Starting with wild inseminated *D. willistoni* from natural populations, four levels of inbreeding were obtained: (a) outcross, about "zero level" (150 strains); (b) outcross with sib mating last (5th) generation, level: 0.39 (101 strains from 608); (c) sib mating 5 generations, level: 0.69 (116 strains from 608), and sib mating 41 generations,near level 1.0 (1 strain from 50). Significantly different egg-adult viabilities were observed among these series: (a): 68.5% (b): 46.9% (c): 29.7% = (d): 32.5%. Levels (b), (c) and (d) strains were sub-cultured in two simultaneous and parallel series of replications, one (R) received 600 r from a Co^{60} source, the other (K) was submitted to the same conditions, except radiation. A total of 127 010 eggs have been counted in these experiments. The most pertinent results are: at the (b) and (c) levels the (K) did not differ from (R). Nevertheless at the (d) level radiation produced an overall enhancement of egg-adult viability; K (d) = 32.53%, R (d) = 44.44% for 10 650 eggs fertilized by control and irradiated spermatozoa. Nevertheless, the spermatozoa produced from irradiated spermatids and spermatocytes showed a slight decrease in a total of 11 230 eggs, K (d) = 32.5% R (d) = 30.8%. The increase of egg-adult viability among the (d) level "low" class is K (d) = 7.53%, R (d) = 40.85%, placing its average viability over that of "high" class after radiations: K (d) = 62.95%, R (d) = 33.74%. The variance increased significantly among the irradiated spermatozoid block, considering that the extremes (high and low) of viability regressed toward the average more among the radiated than between the control the median class showed the greater increase in variance. (From abstr.)

1395 Dobzhansky, T. PROGRESS REPORT (ON BIOLOGICAL RESEARCH), OCTOBER 1, 1962-JUNE 1, 1963. TID-18792, Rockefeller Inst. for Medical Research, New York. 11p.

Results are reported from studies on the nature and magnitude of the genetic load in natural populations of certain species of *Drosophila.* Results are included from experiments on the viability effects of genetic variants in natural populations in homozygous and heterozygous condition, a study of chromosomal variants in a natural population of *Drosophila pseudoobscura,* and genetic loads in irradiated populations of *Drosophila.* (NSA 17: 1963, 24897)

1396 Dobzhansky, T. GENETIC STRUCTURE OF NATURAL POPULATIONS. (Abstr. B1D495) p. 48 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

The aim of this research program is to fill some of the gaps in the basic knowledge on which the judgement of the magnitude of the genetic radiation hazards must rest. Among the crucial questions which are still awaiting solution are: (1) how widespread in natural populations are genetic variants which are detrimental in double dose while favorable (heterotic) in single dose; (2) are such genetic variants merely temporary adaptive expedients, soon to be replaced, as claimed by some authors, by highly fit homozygotes, or do they endure for a long time; (3) are the effects on fitness of the genetic variants found in natural populations more or less constant or dependent on interaction with other variants in the same populations; and (4) are many gene loci represented in natural populations by numerous alleles or only by a single or by two alleles.

1397 Marques, E.K., Winge, H., Napp, M., Maciel, C.M.P. PERSISTENCE OF LETHALS IN IRRADIATED NATURAL POPULATIONS OF Drosophila willistoni. (Abstr. 5.63) p. 76-7 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

An isolated wood in the grassland region of R.G. Sul (Brasil) received during one year 6 releases of about 71 000 individuals F_1 of irradiated samples from a laboratory population originated from the same wood. A total of 45 000 r from a Co^{60} γ-source was delivered to these 6 samples. The F_1 of the last irradiated sample, $6R_1$, as well as the samples collected in the isolated wood, 5 generations ($N6R_1$) and 15 generations ($3N6R_1$) after the release of $6R_1$ have been genetically analyzed for the II and III chromosomes. The $6R_1$ exhibited a significant overload of lethals (II chromosome: 69,75%; III chromosome: 30,87% in regard to its control values from another unirradiated isolated wood (II: 26:34%; III: 19,02%). The allelism increased for each sample: II: $6R_1$ = 6,39% and Control = 1,02%; III: $6R_1$ = 4,00% and Control = 0,29%. This increase persisted 15 generations in nature: $N6R_1$: II = 3,82%; III = 3,22%. This high allelic frequency was maintained in spite of the return to control values of the III chromosome lethals. The II chromosome lethal frequency was still significantly higher than the control (44,44%). The allelism tests intersamples ($6R_1$ X $N6R_1$: II = 5,18%; III = 3,03% and $6R_1$ X Control: II = 0,22%; III = 0,07% allowed us to estimate the radiation induced lethal persistence at the $N6R_1$ to be 75,82% for the II and 89,51% for the III chromosome. The same type of calculations made for the $3N6R_1$ gave 11,48% for the II and 5,30% for the III chromosome, as values of lethal persistence from the $6R_1$, 15 generations after under natural selection. There are indications that several components of the adaptive value were depressed (1) and that chromosomal inversions might "protect" some lethals (2). The persistence of some lethals suggests their complete recessivity as even some balanced effects.

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(1) 1383
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1398 Mourad, A.-K., M. EFFECTS OF IRRADIATION IN GENETICALLY COADAPTED SYSTEMS. Genetics 47, 12 (1962) 1647-62.

(For abstract, see Mourad's thesis, ref. 1399.)

1399 Mourad, A.-K., M. EFFECTS OF IRRADIATION ON GENETICALLY COADAPTED SYSTEMS. Thesis. Columbia Univ., New York. 1962. 42p.

Experimental populations of Drosophila pseudoobscura kept in laboratory population cages, were used to study the effects of exposure to ionizing radiation. The populations were polymorphic for AR and CH gene arrangements in the third chromosomes. Only AR, or only CH chromosomes, were exposed to radiation. Since the gene arrangements were recognizable cytologically, it was possible to follow the destinies of the irradiated and the non-irradiated third chromosomes in the populations. Control experimental populations, with no radiation histories, were also studied. In populations Nos. 2 and 3, flies carrying the AR chromosomes of the foundation stock were exposed to 16 000 r-units of x-rays, and the populations were allowed to breed without further irradiation. The frequencies of AR chromosomes declined at first, but subsequently recovered, and in one of the populations almost reached the same equilibrium state as in the control. In populations Nos. 4 and 5, the CH chromosomes of the foundation stock received 12 000 r-units, and no further radiation was applied. The frequencies of CH chromosomes declined more rapidly than in the control. In populations Nos. 8 and 9, flies carrying the AR chromosomes were treated with 16 000 r of x-rays, and thereafter the populations received in every generation an inflow of AR chromosomes exposed to the same amount of radiation. Compared to the controls, the frequencies of AR chromosomes were depressed, but the polymorphism was nevertheless preserved. (Diss. Abstr., 23; 5: 1962, 1494).

1400 Mukai, T. A RADIATION-GENETICAL CONSIDERATION CONCERNING THE STRUCTURE OF NATURAL POPULATIONS. p. 155-65 in "Proceedings of the Symposium on Genetic Effect of Radiation, Misnima, 7-8 November 1960". Jap. J. Genet. 36, Suppl. The Genetics Society of Japan. 1961. (In English).

According to Dobzhansky's classification (Cold Spr. Harb. Symp. quant. Biol. 20 (1955) 1-15), there are two mutually contradictory hypotheses concerning the genetic structure of natural populations, i.e., the classical hypothesis and the balance hypothesis. From the present study it appears that there are 2 kinds of mutation in Drosophila melanogaster, the balance hypothesis applying to one (about 2/3) and the classical to the other (remaining 1/3). Heterosis seems to be destroyed by spontaneous mutations in the genetic background, but compensated by a high mutation rate. There may thus exist an equilibrium such that mutation at one locus supplies variability of its own but at the same time causes a decrease in variability at other loci.

1401 Oshima, C., Kitagawa, O. HETEROZYGOUS EFFECTS OF INDUCED LETHAL GENES ON PRE-ADULT VIABILITY IN Drosophila melanogaster AND THEIR PERSISTENCE IN EXPERIMENTAL POPULATIONS. p. 167-78 in "Proceedings of the Symposium on Genetic Effect of Radiation, Misnima, 7-8 November 1960". Jap. J. Genet. 36, Suppl. The Genetics Society of Japan. 1961. (In English).

A 2nd chromosome of Samarkand isogenic strain, which was irradiated by x-rays of 500 or 1000 r was isolated by C.M.I. method. The other major chromosomes were substituted by Samarkand chromosomes. 27 lethal genes were obtained and 2 of them were found allelic. These lethals have been maintained by Cy balanced system. The heterozygous effects of each lethal gene on pre-adult viability were estimated on heterozygous and on homozygous genetic background. The mean coefficient of selection on homozygous genetic background was 0,04636 and on heterozygous genetic background it was 0,01640. The genetic background, on which a lethal gene was placed, was proved to have a remarkable influence on the individual heterozygous effect of the lethal gene on viability. No correlation was observed between their coefficients of selection on both genetic backgrounds. Some lethal genes were introduced separately in experimental populations and their individual persistence was observed during about 30 generations. For 1st 10 generations, their decreasing frequencies seemed to depend on the magnitudes of selection coefficients, and later their frequencies gradually decreased at a similar rate that was theoretically assumed ($s = 0$). (Auth. summary)

1402* Pipkin, S.B., Sullivan, W.N. A SEARCH FOR GENETIC CHANGE IN Drosophila melanogaster EXPOSED TO COSMIC RADIATION AT EXTREME ALTITUDE. Aerospace Med. 30 (1959) 585-98.

In all, 10 761 Drosophilae were exposed as larvae to primary cosmic radiation during a balloon flight which remained from 78 000 - 82 000 feet for 16 h. The control series included 7742 individuals. No demonstration of X chromosome breakage or gene mutation at specific X chromosome loci was possible either because of the rarity of thindown hits or of nuclear collisions or because of lethal effects of the former. (Auth. summary).

1403 Bochnig, V. ALTERATIONS OF VIABILITY CHARACTERS IN AN IRRADIATED POPULATION OF Drosophila. (Abstr. 5,59) p. 75 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

Alterations of viability of Drosophila melanogaster have been studied after x-raying a population in its consecutive generations. The population used had been derived from the Berlin wild stock. In each generation 500 males and 500 females (1 - 5 d old) have been irradiated with an acute dose of 2100 r. Up to more than 30 generations of irradiation viability characters have been studied in intervals of about 5 generations by testing lifespan, fecundity, and fertility after application of different x-ray doses ranging from 0 - 100 kr. The results obtained show that in each of the 3 characters studied the irradiated population reached a significantly higher degree of viability than the Berlin wild stock under all experimental conditions. The higher fitness of the irradiated population is explained by an effect of heterosis. A great number of mutations must have been induced by the irradiations and accumulated in the population. As a consequence a higher degree of heterozygosity must have been reached.

1404 Reguly, M.L., Cordeiro, A.R. MUTATIONAL RECURRENCE OR GENETIC COMPENSATION OF LETHALS IN *Drosophila* NATURAL AND IRRADIATED POPULATIONS? (Abstr. 5.60) p. 75 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

The total frequency of 30.3% lethal II chromosomes of *D. willistoni* from an irradiated "A" population do not differ from the control "E" population, 30.5% ($x^2 = 2.17$) (714 strains). This analysis was made 77.5 generations after radiation. The "A" population exhibited 6 out of 10 retested lethals and the "E" 3 of these. Nevertheless, 3 lethal loci are exclusively found in "A" irradiated population. The allelism tests we performed and the calculated average mutation rate per locus in the II chromosome of *willistoni*, 0.000008 obtained from the data of Dobzhansky *et al.** allows the estimation, with Wright's formulae, of the equilibrium levels for each lethal assuming complete recessivity. According these calculations the 6 more frequent induced lethals, still present in population "A" and the 3 spontaneous alleles of "E" population are at 10 to 24.4 times above the expected values. The lethal survival in nature, at such high frequencies, can only be explained by mutation pressures many times above the normal average observed or by overdominant alleles providing genetic compensation or both, by mutational and balanced effects. We suggest that selection of modifiers and or overdominant allelic forms, tends to buffer (balance) the recurrent lethal producing loci.

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* (Genetics 37: 1952, 650)

1405 Saõ Paulo, Brazil. Universidade. Faculdade de Filosofia, Ciencias e Letras. GENETICAL EFFECTS OF RADIATION: A COMPARATIVE STUDY BETWEEN NATURAL LETHALS AND LETHALS INDUCED BY RADIATION IN POPULATION OF *Drosophila willistoni*. Progress Report. TID-17699, 12 Jan. 1963. 15p.

The frequency of mutants in an island population after the introduction of natural and radio-induced mutants was studied. In natural populations lethal genes are eliminated rapidly and non-uniformly, and lethals have strong and variable effects in the heterozygotes. In cages, relatively high frequencies of lethals are still maintained even after 18 generations; the same genes have no deleterious effects in the heterozygotes and, in some cases, even appear to induce an increase in heterozygote viability. In the natural populations no difference was detected between natural and induced lethals and their elimination. In laboratory populations (in 6 out of 8 cases) the frequencies of the radiation-induced lethals dropped below that of the natural lethals after 15 generations of selection. Results are tabulated. Further genetical and statistical analyses are under way. Summarizing, 1) recessive lethals are far from completely recessive; 2) the effects of the lethals in heterozygotes are not absolute but vary with environmental conditions; and 3) recessive lethals, even when heterotic, are almost dominant when the environmental conditions are not too drastic.

1406* Sperlich, D. POSITIVE HETEROSIS EFFECT IN THE STRUCTURALLY POLYMORPHIC SPECIES *Drosophila subobscura*. *Z. VererbLehre* *90* (1959) 273-87. (In German).

A highly polymorphic race was irradiated once in each of 4 successive generations. The shifts found in the next generation in equilibrium frequency of structural heterozygotes were interpreted as due to disturbances of the adaptive gene complexes of the different types. A new inversion induced by the radiation was tested in competition experiment with other structural types and frequency of heterozygotes at equilibrium showed that these had a selective advantage. Here at least the positive heterosis effect must be due to position effect. The primary spread of a new rearrangement may depend on position effect, while with suppression of recombination secondary genic adaptation may occur, which later may mask completely the original position effect. (TID-3098, 4191)

1407 Tantawy, A.O. DEVELOPMENTAL HOMEOSTASIS IN X-RAYED POPULATIONS OF *Drosophila pseudoobscura*. *Genetica* *33* (1963) 222-43.

An experiment was designed to study the effects of various dosages of x-irradiation on different gene arrangements (AR and CH) of the third chromosome of *D. pseudoobscura*, with respect to quantitative characters. Egg production showed an insignificant decline at 1500 r and an increasingly strong reduction by 3000 and 4500 r. Other characters studied (emergence, longevity, body size, and weight) generally showed the same trend. Irradiation of both gene arrangements usually gave more reduction in fitness characters than did irradiation of one gene arrangement alone. Irradiation caused an increase in phenotypic variability as expressed by coefficients of variation. Heterosis in F_1 was observed for most of the characters studied, and a breakdown of heterosis in F_2. Heterosis was enhanced by irradiation at higher dosages. Relative indices of general performance indicate that the adaptive values decreased with the increase in radiation dosages. In all cases the heterozygous genotypes are the fittest while the CH/CH homozygote was the least fit. (Auth.)

1408 Торопанова, Т.А. ЭКСПЕРИМЕНТАЛЬНОЕ ИССЛЕДОВАНИЕ МУТАЦИОННОГО ПРОЦЕССА В ПОПУЛЯЦИЯХ. *Ж. общ. Биол.* *23*, 5 (1962) 359-69.

Toropanova, T.A. EXPERIMENTS ON MUTATION PROCESSES IN POPULATIONS. *Zh. obshch. Biol.* *23*, 5 (1962) 359-69.

Lines of *Drosophila melanogaster* from different ecological background have different natural mutation rates. These differences persist even after the population lines have been subjected to ionizing radiations. In heterozygotes, recessive lethal mutations lead to decreased resistance in the face of unfavourable conditions. (Inhaltsverzeichnisse sowjetischer Fachzeitschriften, ser. IIIB, 12, 1: 1963, 209.4. Tr: MB)

1409 Wallace, B. FURTHER DATA ON OVERDOMINANCE. (Abstr. 5.56) p. 74 in "Genetics Today. Proceedings of XI International Congress of Genetics, The Hague, September 1963. Vol. I". Geerts, S.J., Ed. Oxford, Pergamon Press. 1963.

See 1410.

1410 Wallace, B. FURTHER DATA ON THE OVERDOMINANCE OF INDUCED MUTATIONS. *Genetics* *48*, 5 (1963) 633-651.

A study of x-ray induced mutations (exposures of 0, 250, 750 and 2250 r) in heterozygous condition on the viability of *Drosophila melanogaster* otherwise (1) homozygous for their second chromosomes, (2) heterozygous for 2 different second chromosomes of the same local populations, or (3) heterozygous for 2 second chromosomes of widely separate origins is described; the study comprises nearly 8200 cultures. The data indicate that the newly induced mutations affect the viability of otherwise homozygous individuals differently from that of heterozygotes; they suggest further that on the average the viability of homozygotes is enhanced by new mutations in heterozygous condition while that of heterozygotes is impaired. The differences in viability under analysis are extremely small. (Auth.)

1411 Wallace, B. THE INVESTIGATION OF THE GENETIC STRUCTURE OF POPULATIONS. Period covered: 1 Oct. 1960 - 31 Oct. 1961. TID-14463, New York State Coll. of Agriculture, Ithaca. 30 Nov. 1961. 15p.

The viability effects of newly induced second-chromosome mutations are expressed in heterozygous condition. There appears to be very little effect. Three levels of irradiation (250, 750 and 2250 r x-rays) were used. One interesting point is that the regression of viability on radiation exposure has consistently been positive for flies homozygous for entire second chromosomes while it has been negative for flies carrying two different chromosomes from the same population. At one time, this difference bordered on statistical significance. An analysis of data obtained from Dobzhansky is described which is believed to prove the existence of over-dominance. In brief, if over-dominance does not exist, the viability of homozygous and heterozygous individuals should converge on a common point at the upper end of the viability distribution. In contrast to this expectation, the viabilities of homozygotes and heterozygotes diverge in the region of high viabilities. New work on the study of inversions and deficiencies is also described.

1412 Wallace, B. THE INVESTIGATION OF THE GENETIC STRUCTURE OF POPULATIONS. Period covered: 1 Nov. 1962 - 31 Oct. 1963. TID-19899, Cornell Univ., Ithaca, N.Y. Dec. 10, 1963. 27p.

Results are summarized from studies on radioinduced and spontaneous mutations in populations of *Drosophila melanogaster*. Data are included from a study of the viability effects of spontaneous mutations, the rate at which second chromosome lethals arise by spontaneous mutation, and the effect of these lethals on the viability of heterozygous carriers in populations of *D. melanogaster*. A list is included of papers published as a result of these studies. (NSA 18: 1964, 6618)

1413 Winge, H., Maciel, C.M.P., Napp, M., Marques, E.K. GENETIC EFFECTS OF γ RADIATION ON NATURAL POPULATIONS OF *Drosophila willistoni*. *Experientia* *17* (1961) 406-8. (In English).

An isolated natural population of *D. willistoni* for a year supported a considerable admixture of F_1 Co^{60}-irradiated flies. The genetic analysis showed that the frequency of the lethal and semilethal alleles after 5 generations decreases rapidly to the normal. The frequency of the lethal alleles was still high. After

15 generations it decreases to the level of the natural control populations. Individual lethal alleles produced by irradiation remain in the population. (Auth.)

See also:

745 Entomological aspects of radiation as related to genetics and physiology. (Grosch, 1962)
790 Influence de l'irradiation sur les adultes de *Sitophilus sasakii* Takahashi (Curculionidae) et leurs descendants. (Laviolette and Nardon, 1963)
791 Action des rayons γ du cobalt 60 sur la mortalité et la fertilité des adultes d' un charançon du riz. (Laviolette and Nardon, 1963)
1050 Effects of a prolonged exposure of artifical populations of *Drosophila melanogaster* to $MnCl_2$. (Carfagna *et al.*, 1963)
1208 Changes of reproductive performance of *Drosophila willistoni* at two inbreeding levels. (Centeno *et al.*, 1963)
1310 Changes in quantitative traits under selection and irradiation. (Bartlett, 1963)
1314 Répercussion de l'influence des rayons γ dans la descendance de *Sitophilus sasakii* (Takahashi) (Coléopt. Curcul.) (Nardon, 1962)
1385 Research in genetics. (Stone, 1963)
1477 Control of insect populations through genetic manipulations. (LaChance and Knipling, 1962)

I-C-5 ECOLOGY

1414 Erdman, H.E. EFFECTS OF RADIATION ON ECOLOGICAL SYSTEMS. (Abstr. E1A774) p. 127 in "Research and Development in Progress. Biology and Medicine. Issue No. 2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Tribolium confusum and *T. castaneum* are excellent for studies of radiation effects upon populations in competition because they occupy the same ecological niche. *T. castaneum* is more tolerant to radiation than *T. confusum* except in the egg stage when their sensitivities are the same. Sterility is induced in *T. castaneum* by 6 kr x-rays and closely approached by 4 kr. After adults had been exposed to a single dose of x-rays, a decrease in lethals among progeny with time and a differential radiosensitivity of gametes for both species were observed. Twenty kr x-rays inhibit larval development in *Ephestia* and a difference was noted in the haemolymph protein fractions between x-rayed and control larvae 1 month after treatment. Ingestion of 0.03 - 0.04 μc Pu^{239} /*Habrobracon* wasp induced temporary sterility; 0.11 - 0.14 μc produced permanent sterility. Future studies are discussed.

1415 Platt, R.B. ECOLOGICAL EFFECTS OF IONIZING RADIATION ON ORGANISMS, COMMUNITIES AND ECOSYSTEMS. p. 243-55 in "Radioecology. Proceedings of 1st National Symposium on Radioecology, Colorado State University, Fort Collins, 10-15 September 1961". New York, Reinhold Publishing Corp. 1963.

Some mention of the differences in radiation sensitivity is made on p. 248, with special reference to the extreme case of *Drosophila*. Median lethal doses for embryos aged 3, 4, and 7½ h range from 170 - 200, 500 to 810 r, rising to 2800 and 85 000 r for pupae and adults, respectively.

1416 Stone, W.S., Wheeler, M.R., Wilson, F.D. GENETIC STUDIES OF IRRADIATED NATURAL POPULATIONS OF *Drosophila*. V. SUMMARY AND DISCUSSIONS OF TESTS OF POPULATIONS COLLECTED IN THE PACIFIC PROVING GROUND FROM 1955 THROUGH 1959. p. 1 - 54 in "Studies in Genetics, II. Research Reports on Drosophila Genetics, Taxonomy and Evolution". Wheeler, M.R., Ed. Austin, The University of Texas. 1962.

Samples of the circumtropical species, *Drosophila ananassae*, were collected in July and August for a 5-year period, 1955-9, from islands in the USAEC Pacific Proving Ground area. Estimates of the different dosages received by the various populations are given. The ecology of these island populations was studied to determine competitors, predators, food, and the effect of man-induced changes (destruction of habitat, insecticide sprays, etc.). The general and comparative sizes of the populations were determined as far as possible. Samples were tested every year for viability, fertility, and fecundity. A quite consistent finding was the great variability of the smaller atoll populations as compared to the relatively large population on Ponape. Part of this is due to lesser ability to resist fluctuation with environmental change. Another very interesting finding is that isolating factors which reduce fecundity in crossmatings and crossfertility had developed between several of these populations.

1417 Woodwell, G.M. ENVIRONMENTAL BIOLOGY: EFFECTS OF IONIZING RADIATION ON ECOSYSTEMS. (Abstr. E1A1086) p. 132-3 in "Research and Development in Progress. Biology and Medicine. Issue No. 2". TID-4201, Division of Technical Information, AEC. Nov. 1963.

Two principal field experiments have been established: one utilizing an old field in the Brookhaven γ radiation field and a second involving a new irradiation facility in a near climax forest. Secondary effects, especially those involving insect populations, could be shown to be of great importance in analyzing the effects of low-level irradiation on ecosystems.

See also:

1388 Chromosomal aberrations in a natural population of *Chironomus tentans* exposed to chronic low-level environmental radiation. (Blaylock, 1963)
1389 Population genetics and radiation effects studies on *Chironomus tentans*. (Blaylock *et al.*, 1963)
1408 Experiments on mutation processes in populations. (Toropanova, 1962)

II APPLICATIONS

II-A Articles. Surveys

1418 Baccetti, B. L'ENERGIA ATOMICA NELLA LOTTA CONTRO GLI INSETTI. (Atomic energy in the fight against insects.) Acad. econ. agrar. Georgofili IX, 7 (1963) 1-18 and 319-34. (In Italian)

Review article, dealing with applications of radiation (sterile male technique, mostly).

1419 Boroughs, H. THE USE OF IONIZING RADIATION FOR INSECT CONTROL IN LATIN AMERICA. Int. J. appl. Rad. Isotopes 13 (1962) 441-3.

Review of small-scale projects, so far mostly under consideration.

1420 Boroughs, H. THE USE OF IONIZING RADIATION FOR INSECT CONTROL IN LATIN AMERICA. Turrialba 13, 1 (1963) 32-4. (In Spanish, with English summary).

Review article, emphasizing work on radiation-induced sterility.

1421 Horne, T., Brownell, L.E. THE USE OF RADIATION SOURCES FOR INSECT CONTROL. p.233-50 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Review article. Different radioisotopes and electrical machine sources of radiation are briefly discussed, greater emphasis being placed on radioisotpes because of their greater reliability and ease of operation. The numbers of curies of the most suitable isotopes for various applications are tabulated. The general principles of source design covering radiation flux intensity, optimum dose distribution, and shielding requirements are outlined. Various procedures for the use of radiation in control of insect populations are reviewed, including the sterile-male release technique, direct irradiation of agricultural products, the combined use of insecticides with irradiation, and the possible use of radiation as an insect repellent. Possible new applications are suggested. A new method for storing grain for a long time without the need for periodic fumigation involves the use of a special grain container and radiation processing. Designs for various irradiators and some of the problems encountered are reviewed. Special reference is made to small semi-portable irradiators suitable for insect sterilization; to a flexible laboratory irradiation unit covering both research and field scale applications; and to some of the large production scale facilities proposed for commercial use. (From auth.)

1422 International Atomic Energy Agency, Vienna. INFORMATION CIRCULAR ON RADIATION TECHNIQUES AND THEIR APPLICATION TO INSECT PESTS. WP/31/1. Mar. 1963. 14p.

The circular is aimed at disseminating research information to research workers in the field. The following topics related to the sterile male technique and allied problems will be covered: insect tagging techniques; tracer application in ecology, e.g. flight range determinations; insect population dynamics; development of mass rearing techniques; effects of radiation on insects; radiation sterilization applications; and irradiation of commodities and materials to control insects. The first 15 abstracts refer to papers presented at the 1963 Panel meeting (see Lindquist, 1434) abstracts 1-6 deal with insects affecting animals, 7-12 with fruit flies, and 13-15 with other insects. Items 16-22 are communications to I.A.E.A.

1423 International Atomic Energy Agency, Vienna. INFORMATION CIRCULAR ON RADIATION TECHNIQUES AND THEIR APPLICATION TO INSECT PESTS. Nr. 2. WP/31/2. July 1963. 27p.

Summaries are presented of 46 papers covering various aspects of applications of radioisotopes in studies of insect pests of interest in agriculture. Emphasis is placed on the use of labeled insects and their parasites in studies of the migration, population density, and metabolism of insect pests. The effect of radiation on insects during various developmental stages, radioinduced mutations in insects, and the release of irradiated males as a means of control are also discussed. (NSA 18: 1963, 3439).

1424 International Atomic Energy Agency, Vienna. INFORMATION CIRCULAR ON RADIATION TECHNIQUES AND THEIR APPLICATION TO INSECT PESTS. WP/31/3. Dec. 1963. 19p.

Of the 51 communications listed, 5 covered ecological studies, 15 effects of ionizing radiations, 2 rearing techniques, 7 radiation sterilization, and 22 chemosterilants. As yet unpublished information was communicated by W. Kloft on carpenter ant colonies (Camponotus sp.), using I^{131}; J.A. George on γ-radiation on the Oriental fruit moth, Grapholitha molesta (Busch); H. Huque on the susceptibility to γ-radiation of various developmental stages of the locust; K.P. Katiyar on the possible use of the sterile male technique for dealing with Ceratitis capitata in Central America; and some further trials by M.D. Proverbs of the sterile-male technique with the codling moth, Carpocapsa pomonella.

1425 Macko, V., Jasič, J. VYUŽITIE GAMA ŽIARENIA V APLIKOVANEJ ENTOMOLOGII. (The use of γ-radiation in applied entomology). Polnohopodarstvo 8, 2 (1961) 139-47. (In Czech, with Russian summary)

The two main applications for pest control and eradication, in terms of direct action or the sterile male technique, are discussed.

1426 Rukavishnikov, B.I. POSSIBLE USES OF IONIZING RADIATION FOR STERILIZING AND DESTROYING INSECT PESTS. Rastenievodstvo, sel'skoe hozjajstovo za rubežom 3 (1963) 53-8.

1427 Stone, W.E. EFFECTS OF IONIZING RADIATION ON INSECTS AND OTHER ARTHROPODS. p. 301-9 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

The influence of γ-radiation is described on the reproductive potential, sexual aggressiveness, vigour and longevity of the oriental fruit-fly, Dacus dorsalis Hendel, the melon-fly, Dacus cucurbitae Coq., the Mediterranean fruit-fly, Ceratitis capitata Wied., the Mexican fruit-fly, Anastrepha ludens Loew, and Anopheles quadrimaculatus Say, and results of practical field trials of the sterile-male release method of population suppression. Progress in the campaign to eradicate the screwworm, Cochliomyia hominivora Cqrl. in the United States and in studies to develop vigorous genetically marked strains that will permit ready identifications of released sterile flies is reviewed. Results of irradiation research on additional species that infest fruit, vegetable, field and forest crops, that attack livestock, that largely affect man, the effects of irradiation on the scorpion, Centruroides limpidus Karsch, and the one-Star tick, Amblyomma americanum L., and ionizing radiation as a possible quarantine treatment for fruits and vegetables infested with fruit flies and mangoes infested with the mango weevil, Sternochetus mangiferae Fabricius, are also discussed. (From auth.)

1428 Waterhouse, D.F. INSECT CONTROL BY RADIATION STERILIZATION IN AUSTRALIA. Int. J. appl. Rad. Isotopes 13 (1962) 435-9.

A review article. The use of the method for grain disinfestation is discussed. Consideration is also being given to sterilizing doses for controlling fruit fly in fruit moving into quarantine areas and Sirex- or Hylotrupes-infested timber entering Australia at mainland ports. 5-10 000 r affect fly but not fruit, and 600 000 c from a Co^{60} source are already used by a carpet manufacturer. Problems connected with Dacus tryoni (Frogg.), the Queensland fruit fly, and Lucilia cuprina, the Australian sheep blowfly, are discussed.

See also:

766 The application of nuclear energy to agriculture. (Boroughs, 1962).
1570 Use of radioisotopes and radiation in the control of plant and animal insect pests. (Andreev, et al., 1963).
1576 The use and limitations of isotopes and radiation sterility in meeting insect problems. (Knipling, 1962).

II - B Population Control

II-B-1 STERILE MALE TECHNIQUE

1429 Christenson, L.D. CONTROL OF INSECT PESTS BY RADIATION STERILIZATION TECHNIQUES. p. 169-88 in "Applications of Radioisotopes and Radiation in the Life Sciences 1961". Hearings before the Subcommittee on Research, Development, and Radiation of the Joint Committee on Atomic Energy, Congress of the United States. 87th Congress, 1st Session, 27-30 March 1961.

Review article. Methods for mass production, sterilization, and distribution of insects are described. In addition to the screw-worm fly, the method was also used to control melon flies and fruit flies. Sterilization studies with mosquitoes, the pink boll worm, codling moths, corn earworm, fall armyworm, sugarcane stalk borer, boll weevil, tobacco budworm, sheep blow fly, tsetse fly, and other insects are underway or planned. Radiation may also be useful as a quarantine treatment for insect-infested commodities. Dosages of 10 000 to 20 000 r were found to destroy the reproductive potential of immature stages of fruit flies in fresh fruit and vegetables.

1430 Чувахин, В.С. ПОЛОВАЯ СТЕРИЛИЗАЦИЯ КАК МЕТОД БОРЬБЫ С ВРЕДНЫМИ НАСЕКОМЫМИ. Защ. Раст. 2 (1961) 45-?

Chuvakhin, V.S. SEXUAL STERILIZATION AS A MEANS OF CONTROLLING INSECT PESTS. Zashch. Rast. 2 (1961) 45-?.

1431 Delattre, R. NOTE SUR LES POSSIBILITÉS DE LUTTE AUTRES QUE LES INSECTICIDES. p. 267-70 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency, 1962.

Une nouvelle méthode de lutte par irradiation des mâles a récemment fait ses preuves aux Etats-Unis; il serait très intéressant et il paraît possible de partir de cette donnée pour l'appliquer au problème des Dysdercus en pays tropicaux. Elevage et expérimentation de base sont possibles en métropole, attractifs et mouvements des populations simplifieraient la mise en pratique de l'irradiation. L'intérêt économique final serait considérable pour les Etats d'Outre-Mer, en cas de réussite d'un tel projet. (Aut.)

1432 Féron, M. LA LUTTE CONTRE LES INSECTES PAR LES MÉTHODES AUTOCIDES. Rev. Zool. agric. 62, 4-6 (1963) 37-48.

Discussion sur le contrôle contre les insectes au moyen de lâcher de mâles stérilisés par irradiation.

1433 Kansu, A. BÖCEKLER ILE SAVAŞTA YENI BIR METOD: RAYASYONDAN YARARLANMA. (A new method to control insects: usage of radiation.) Bitki Koruma Bült. 2, 12 (1962) 40-60. (In Turkish, with English summary)

Review article, with particular reference to work leading to the application of the sterile-male technique.

1434 Lindquist, A.W. INSECT POPULATION CONTROL BY THE STERILE-MALE TECHNIQUE. COMPREHENSIVE REPORT OF A PANEL, HELD IN VIENNA 16 - 19 OCTOBER 1962. Technical Reports Series Nr. 21. Vienna, International Atomic Energy Agency. 1963. 59p.

After the successful work on screwworm eradication, the factors influencing the induction of sterility and some aspects of nutrition and the mass culture of insects are reviewed. The suitability for mass releases of sterile males is considered for the following species: the Australian sheep blowfly (Lucilia cuprina (Wied.) and L. sericata); the New Guinea screwworm (Chrysomyia bezziana Villen.); the tropical ox warble (Dermatobia hominis (Linn.); the tsetse fly (species Glossina); the fruit fly (Anastrepha ludens); the oriental fruit and melon flies (Dacus dorsalis (Hendel) and D. cucurbitae (Coq.); the Queensland fruit fly (D. tryoni (Frogg); the olive fly (D. oleae (Gmelin); the codling moth (Carpocapsa pomonella (L.); crop insects [sugar-cane borer: Diatraea saccharalis (Fab.), European corn borer: Ostrinia nubilalis (Häbn.), pink bollworm: Pectinophora gossypiella (Saunders), boll weevil: Anthonomus grandis Boheman, fall army worm: Laphygma frugiperda, and Drosophila melanogaster]; the Mediterranean flour moth, Anagasta kühniella Zell; and some other grain pests. Results obtained by groups of scientists in different countries are reviewed and their problems discussed. Recommendations are made.

1435 Smith, C. N. PROSPECTS FOR VECTOR CONTROL THROUGH STERILIZATION PROCEDURES. Bull. World Hlth Org. 29, Suppl. (1963) 99-106.

Applications of radiosterilized insects for their own destruction are reviewed. The present position regarding vector control by sterilization procedures is discussed, with special reference to chemosterilants.

1436 Weidhaas, D. E., Schmidt, C. H., Chamberlain, W. F. RESEARCH ON RADIATION IN INSECT CONTROL. p. 257-63 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

A summary of the development and application of the sterile-male release technique, in which γ-radiation was used as the sterilant, in the eradication of the screwworm, Callitroga hominivorax (Cqrl.), is presented. Preliminary laboratory and field results on the application of this same technique to the control or eradication of mosquitoes, Anopheles quadrimaculatus (Say), and fruit flies, (Mediterranean), Ceratitis capitata (Weid.), the oriental fruit fly, Dacus dorsalis, (Hendel) and the melon fly, Dacus curcurbitae (Coq.) are presented. Results are also given showing the lethal effects of radiation on some insects of medical importance, including the body louse (Pediculus humanus humanus L.), housefly (Musca domestica L.), American cockroach (Periplaneta americana (L.)), German cockroach (Blattella germanica (L.)), firebrat (Thermobia domestica (Pack.)), bed bug (Cimex lectularius L.), and the Pharaoh ant (Monomorium pharaonis (L.)). (Auth).

See also:

54 Mating behaviour of Anopheles stephensi. (Quraishi and Arthur, 1963).
761 Study of the dose-dependence on the survival rate and the sexual sterilization of the granary weevil (Calandra granaria). (Andreev et al., 1962).
763 Radiation-induced sterility in the insect Rhodnius prolixus. (Baldwin and Shaver, 1963).
774 Exploratory studies on gamma radiation for the sterilization of the boll weevil. (Davich and Lindquist, 1962).
804 Quelques résultats supplémentaires concernant l'influence des rayons gamma sur les chrysalides et les œufs de la teigne de la farine "Ephestia kühniella Zell" (Pelerents, 1963).
807 Somme effects of gamma radiation on the reproductive potential of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962).
808 Suppression of the reproductive potential of the codling moth by gamma irradiated males in caged orchard trees. (Proverbs and Newton, 1962).
809 Sterilization of the codling moth by gamma-irradiation. (Proverbs, 1962).
815 Sterilization of Dacus oleae by gamma radiation. (Thomou, 1963).
817 Evaluation of control of European corn borer, Ostrinia nubilalis (Hubner), by x-ray induced sterility. (Walker, 1962).
818 Effect of x-ray exposure on the European corn borer. (Walker and Brindley, 1963).
821 Gametogenesis in the sugarcane borer moth Diatraea saccharalis (F.) (Crambidae). (Virkki, 1963).
878 Mutations in the screw-worm fly. (La Chance and Hopkins, 1962).
1045 Influence of aeration during gamma irradiation of screw-worm pupae. (Baumhover, 1963).
1227 Effects of gamma radiation on various stages of three fruit fly species. (Balock et al., 1963).
1237 Control of the Mediterranean flour moth Anagasta kühniella Zell by sterile male release. II. Susceptibility to gamma radiation. (Bull and Wond, 1963).
1283 Influence of gamma radiation on the development and fertility of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962).
1284 Influence of gamma radiation on the development and fertility of the codling moth, Carpocapsa pomonella (L.) (Lepidoptera: Olethreutidae). (Proverbs and Newton, 1962).
1375 The importance of competitiveness of radiosterilized males in mosquito-control programs. (Dame and Schmidt, 1962).
1378 Mating ability of male mosquitoes, Aedes aegypti (L.), sterilized chemically or by gamma radiation. (Weidhaas and Schmidt, 1963).

II-B-1-a COLEOPTERA

Scarabaeidae
Melolontha vulgaris

1437 Horber, E. ERADICATION OF WHITE GRUB (Melolontha vulgaris F.) BY THE STERILE-MALE TECHNIQUE. p. 313-31 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency., 1963.

Laboratory tests indicated that a minimum dose of 3000 r (or 3000 – 5000 r) x-rays was necessary to induce sterility in male cockchafers. During 2 flight period, sterilized males were released in a general farming region of north-western Switzerland. In 1959 five areas, each ~ 30 ha, were selected to serve as: (a) the treated area, where the males were captured, irradiated and released; (b) the "bank", where cockchafers were collected and the males irradiated for release in (a); and (c) control areas, where undisturbed gradation was observed. A therapeutical x-ray unit was used, and irradiated males hand-painted to estimate the ratio of sterilized males by the isotope dilution technique. In 1959, 61 sterilized males (~ 50% of male population) were released in (a). Infestation in grassland dropped to ~ 2/3 of that in other areas, reproduction rate to < 1 in (a) only, and (by 1962) reduction to 1/10 of that in (b) and (c). Greatest mortality (1959-1962) occurred in (a). In 1962, 171 irradiated males were released in (a) (~ 76% of population had been sterilized). Complete eradication was obtained in (a). The sterile-male technique may therefore also be applied successfully in an area which is not strictly isolated geographically, to a species where the females mate several times and where mass-breeding is not feasible because of the long breeding cycle.

II-B-1-b DIPTERA

II-B-1-b-i Calliphoridae
Cochliomyia hominivorax
Lucilia sericata

1438 United States Department of Agriculture, Agricultural Research Service. QUESTIONS AND ANSWERS ABOUT SCREWWORM ERADICATION. ARS 91-38. November 1962.

Brief but concentrated information bulletin on screwworm eradication dealing, in question-and-answer-form, with such aspects as damage, occurrence and spread, programs under way, sterile-fly production plant, release routine, barrier zones, and the livestock producers' role.

1439 Bushland, R. C. RESEARCH TO SUPPORT THE SOUTHWESTERN SCREW-WORM ERADICATION PROGRAM. (Abstr. 236). Bull. ent. Soc. Amer. 8, 3 (1962) 164.

A team doing intensified research on screwworms has made progress in the development of: 1) new radiation techniques, 2) genetic markers for adults and larvae, 3) a chemically defined larval diet, and 4) inexpensive rearing media. Laboratory and field ecological observations are a guide to improved techniques in sterile-fly release procedures. (Auth).

1440 Hightower, B. G. NOCTURNAL RESTING PLACES OF THE SCREW-WORM FLY. J. econ. Ent. 56, 4 (1963) 498-500.

Large numbers of screw-worm flies, Cochliomyia hominivorax (Coquerel), the pupae of which had been exposed to 7500 r of γ-radiation on the 5th day following pupation, were marked with tracing powder fluorescent under ultra-violet light and released in the field in the afternoon and recovered during systematic searches on following nights. Flies tended to congregate at streams and pens of livestock, but recoveries from even the most favoured locations were not large. More than 90% of recovered flies were found resting on small leafless twigs in low-canopy trees. Essentially (Auth. summary).

1441 Hightower, B. G., Alley, D. A. LOCAL DISTRIBUTION OF RELEASED LABORATORY-REARED SCREWWORM FLIES IN RELATION TO WATER SOURCES. *J. econ. Ent.* *56*, 6 (1963) 798 - 802.

All the male and female screwworm flies released were reared in the laboratory on a standard diet and had been exposed to a sterilizing dose of γ-radiation as pupae. The techniques for rearing, holding, and sterilizing the insects remained the same throughout the experiments, but there were variations in the methods and rates of releasing the adults. However, all flies were more than 4 and less than 24 h old at the time of release. All the flies were marked with acetone-soluble or fluorescent dyes. Two series of field releases of marked laboratory-reared screwworm flies, *Cochliomyia hominivorax* (Coquerel), were carried out in southwest and central Texas to determine the local distribution of the flies in relation to stock ponds and streams. According to samples based on liver-baited trap catches, flies released in a semi-arid brushy area with no running streams tended to congregate around stock ponds. Flies released in an area crossed by running streams continued to disperse beyond a stream 0.8 to 1 mile from the release point to points on a second stream up to 1 mile beyond the first stream. Evidence is presented that the flies were channelled to some traps by terrain features. Local concentrations of flies on the stream nearest the release point persisted for 3 to 4 d. Peak catches of flies were noted on the third day following release. During the hot dry weather of late summer flies could not be detected along either stream.

1442 MacLeod, J., Donnelly, J. FAILURE TO REDUCE AN ISOLATED BLOWFLY POPULATION BY THE STERILE MALES METHOD. *Ent. exp. appl.* *4* (1961) 101 - 118.

In 1956 and 1957 pupae of *Lucilia sericata* were irradiated at 6000—7000 rep, and allowed to emerge at 3 points on Holy Island. The sterilized population was maintained in preponderant numbers by regular replenishments. A test in 1958 showed no reduction in the density of the species. Possible causes of failure of the method are examined, such as over-estimation of the field longevity of the sterilized flies; under-estimation of the native density; loss of radioactive label (e. g. through delay in pupation and emergence); reduced response of treated flies to bait-traps; inefficient sterilization; recovery of fertility; grossly reduced viability of sterilized animals; some specific unsuitability arising for physiological reasons; or failure for ecological reasons (e. g. losses from predators). It is concluded that either the sterilization was inadequate or that the sterilized males were unable to compete with the native males.

See also:

1227 Effects of gamma radiation on various stages of three fruit fly species. (Balock *et al.*, 1963).

II-B-1-b-ii *Culicidae*

Aëdes aegypti
Anopheles quadrimaculatus
Culex fatigans

1443 McCray, E. M., Jr., Jensen, J. A., Schoof, H. F. COBALT - 60 STERILIZATION STUDIES WITH *Aedes aegypti* (L.). *Proc. N.J. Mosq. Ext. Ass.* *48* (1961) 110-15.

Exposure of *A. aegypti* pupae to 10 500 to 17 500 r of γ-irradiation caused complete sexual sterilization of both males and females (mortality $< 10\%$). Caged populations containing 500 irradiated males, 25 normal males, and 25 normal females produced eggs of which $< 2\%$ were viable. At a ratio of 10 : 1 : 1 of sterile male : normal male : normal female, the viable egg production was $< 10\%$. Rearing, sterilizing and shipping procedures were established by which about 110 000 — 160 000 sterilized male pupae were produced and sent by air twice weekly from July to November 1960 from Savannah to a release site about 450 miles away.

1444 Morlan, H. B., McCray, E. M., Jr., Kilpatrick, J. W. FIELD TESTS WITH SEXUALLY STERILE MALES FOR CONTROL OF *Aedes aegypti*. *Mosquito News* *22*, 3 (1962) 295-300.

Tests in Escambra County, Florida, are reported and natural populations of *A. aegypti* are compared in 2 areas of sterile-male release and in 2 untreated check areas. The male pupae were sterilized by exposures to 11 000 to 18 000 r γ-rays, and were usually distributed within 24 h of irradiation. Results are tabulated. The extent of dispersion of sterile males from a limited distribution of irradiated pupae was unknown. Laboratory studies have indicated that a few days' difference in age of males favours mating success of the younger mosquitoes. Thus, the 1961 releases of only once a week, whilst desirable from the view-point of logistics, were probably less effective for *A. aegypti* control than the twice-weekly releases of 1960.

1445 Fay, R. W., McCray, E. M. Jr., Kilpatrick, J. W. MASS PRODUCTION OF STERILIZED MALE *Aedes aegypti*. *Mosquito News* *23*, 3 (1963) 210-4.

For mass production of sterilized male pupae modifications are described in the rearing of large numbers of mosquitoes, in obtaining higher production of male pupae from the rearing trays, in separating the pupae from the larvae through the use of paris green or magnetic iron oxide dust, and in reducing the range of the irradiation dosage during the sterilizing process. Studies were also made on the mating competitiveness of sterile and normal adult males 2 - 7 d old. (From auth. summary).

1446 Weidhaas, D. E., Schmidt, C. H., Seabrook, E. L. FIELD STUDIES ON THE RELEASE OF STERILE MALES FOR THE CONTROL OF *Anopheles quadrimaculatus*. *Mosquito News* *22*, 3 (1962) 283-91.

Geographical conditions under which releases were made are described, and the methods adopted for rearing and for evaluating egg viability, adult counts, etc. For sterilization, pupae $<$ 24 h old were exposed to 12 000 r of γ-rays (Co^{60}). The subsequent procedure is described. Monthly abundance of female *quadrimaculatus* was checked for the various locations. In the Lake Okeechobee experiment the release of sterile males may have influenced the abundance of *quadrimaculatus* during the first half of the experiment when the natural population was in a seasonal decline, but it had no effect when the natural population increased during the 2nd half of the test. Release of sterile males in the Lake Panasoffkee area did not conclusively demonstrate any induced sterility.

1447 Ramakrishnan, S. P., Krishnamurthy, B. S., Ray, S. N., LABORATORY STUDIES ON THE USE OF IRRADIATED STERILE MALES TO REDUCE *C. fatigans* Wied. POPULATIONS. *Indian J. Malar.* *16*, 4 (1962) 357 - 64.

Irradiation of pupae (whether by x- or γ-rays) affected longevity. Tables give data on dosage (x-rays: 14 000 and 30 000 r; γ-rays: 2850 to 11 550 r); mortality of irradiated pupae, number of irradiated males crossed with normal females; number of egg-rafts from mated females; viability of egg - rafts; level of sterility obtained, experimental ratios used in mating, and mortality rates. Mosquito sterilization with minimum mortality was obtained with 7700 r of γ-rays. Maximum non-viability of eggs was obtained when the proportions of sterile to normal males to females was 9 : 1 : 1. A ratio of 2 : 1 : 1, which is more practicable, gave 38 - 40% non-viability.

1448 Krishnamurthy, B. S., Ray, S. N., Joshi, G. C. A NOTE ON PRELIMINARY FIELD STUDIES OF THE USE OF IRRADIATED MALES FOR REDUCTION OF *C. fatigans* (i.e. *Culex pipiens quinquefasciatus*) Wied. POPULATIONS. WHO/EBL/6, WHO/Vector Control/14. Geneva, World Health Organization. 9 Jan. 1963. 11 p.

In small-scale preliminary field trials undertaken by the Central Institute for Communicable Diseases, sterile male *Culex fatigans* were released with a view to assessing the effect on a wild population. Two villages, Aslatnagar for the releases and Karkarmandan for control purposes, were the test areas. No reduction was achieved in the adult or larval densities. The particular circumstances prevailing (non-cooperation of the local people) prevented the release of really large numbers of sterile males. The increase of sterile males in the *C. fatigans* population appeared to be followed by an increase in the percentage of rafts with embryonated but unhatched eggs. Thus, the possibility of using irradiated sterile males to effect reduction of *C. fatigans* populations in the field appears to be precluded.

Also published in *Indian J. Malar.* *16*, 4 (1962) 365-73.

II-B-1-b-iii *Glossinidae*

Tsetse fly

1449 Knipling, E. F. POTENTIAL ROLE OF THE STERILITY PRINCIPLE FOR TSETSE FLY ERADICATION. WHO/Vector Control/27, WHO/EBL/9, World Health Organization, Geneva. 10 Apr. 1963.

A mathematical model was established on the basis of a low-level population of 200 flies/sq. mile. The time for one complete generation is taken as 3 months, maximum net increase potential 50%/generation. It is assumed that the releases are reduced by half for each period or generation, the natural male population being outnumbered 3 : 1 at the start. Theoretically, the rate of decline in the natural population is greater than the reduction in sterile males. On the basis of the population dynamics of tsetse flies in general, an initial release rate as low as 2 : 1 may be expected to start a downward trend in the natural population. \$500/sq. mile is necessary to achieve fly eradication by the application of selective residual insecticides to the vegetation or for aircraft mist spraying. The sterility method might become practicable at already $125/sq. mile. Economic and other considerations are discussed relating to various population densities and the prevention of re-infestation, mass rearing (difficulties and assumed high cost), and the use of sterile males as an adjunct to other tsetse fly control measures. Other methods for producing sterility, in particular the development of chemosterilants are reviewed. The kind of research needed at this stage is outlined.

II-B-1-b-iv Muscidae
Musca domestica

1450 Rivosecchi, L. UN ESPERIMENTO SUL CAMPO CON MASCHI IRRADIATI DI Musca domestica IN UNA ZONA RURALE DELLA PROVINCIA DI LATINA. (An experiment in the field with irradiated male Musca domestica in a rural zone in the Province of Latium). Riv. Parassit. 23, 1 (1962) 71-4. (In Italian)

The chosen area was situated between the coast, the lakes Monaci and Caprolace, and included 4 country houses. Previous prolonged insecticide treatment had been applied. Sterile males were released in March. By April, sterile females had begun to appear and the population of females was greatly reduced over the following 2 months. No sterile males were released after early July. Tests for fertile females were made in August. Their number gradually increased until it became predominant within a month. It is not clear whether incomplete isolation of the test area or insufficient competitiveness of the irradiated males were responsible for failure of the treatment. - The optimum dose applied to pupae was 2000 r. Below are various ratios of normal female: normal male: irradiated male, and their results. 1 : 1 : 2 produced 50% sterility 1 : 1 : 4 - 60%, 1 : 1 : 6 - 70%, 1 : 1 : 10 - 20 - 90 - 99%, there was no improvement when the ratio was increased to 1 : 1 : 30 since some fertile eggs always remained.

II-B-1-b-v Tephritidae
Ceratitis capitata
Dacus (various)
Dacus oleae

1451 Edwards, B.A.B. THE FRUIT FLY PROBLEM IN AUSTRALIA. Outlook Agric. 3, 4 (1961) 116-22.

General review. Two species of fruit fly, the Queensland fruit fly [Strumeta tryoni (Frogg.)], now well established in Queensland and coastal New South Wales and, to a lesser extent, in Victoria, and Ceratitis capitata (Wied.), now restricted to Western Australia, cause serious economic loss. So far, biological control (parasitic insects) has not proved very effective. The merits of dipterex, Rogor and Lebaycid sprays, and of male suppression by lure traps are discussed. According to J.G. Gellatley the release of irradiated sterile males is being investigated for S. tryoni control.

1452 Katiyar, K. POSSIBILITIES OF ERADICATION OF THE MEDITERRANEAN FRUIT FLY Ceratitis capitata Wied. FROM CENTRAL AMERICA BY GAMMA-IRRADIATED MALES. p. 211-17 in "4th Inter-American Symposium on the Peaceful Application of Nuclear Energy, Mexico City, 9-13 April 1962." Washington, D.C., Pan American Union. 1962.

Mass production of the fly in the laboratory is economically feasible. Owing to local topography and to the fact that at certain seasons the natural population density of this fly is extremely low, prospects for a successful application of the sterile male technique are very good. A cooperative project was started to study this problem on a field scale in a single region in Costa Rica. Preliminary experiments with the Cs^{137} irradiator in the gamma field have shown that when pupae (about 85-90% developed) are irradiated with 10-13 kr, sterility can be induced in adults without any deleterious side effects on longevity and mating. A Co^{60}-pool irradiator will be used for field experiments. The dispersal habit and longevity of the fly will be studied in nature by releasing radio-isotope labelled adults. Sr^{89} was tried in larval feeding tests but proved not very successful. P^{32} was adopted for labelling adults which could be achieved by adding the isotope to either the larval rearing medium or to adult food; the latter proved more effective and cheaper.

1453 Moh, C.C. THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. A SUPPLEMENTARY REPORT. TID-16328, Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica. 1 July 1962. 28p.

Various studies are reported. The feasibility of releasing radiation-sterilized males in an attempt to eradicate the Mediterranean fruit fly, Ceratitis capitata, in Central America was investigated, and results of some preliminary radiation experiment are reported.

1454 Moh, C.C. THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE IN LATIN AMERICA. (Abstr. K1B391). p. 163-4 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

Apart from the training of Latin American students in the use of radioisotopes, various agricultural projects are under way. The relation between dosage and sterility in Ceratitis capitata Wied. was studied; 10 kr of γ-radiation is capable of inducing dominant lethal mutations in all sperm. Studies on the effects of different atmospheric conditions on the mating vigour and sperm production of the male, and the radiosensitivity of spermatogenesis at different stages are being carried out. (From abstr.)

1455 Katiyar, K., Valerio, S.J. STERILIZATION OF THE MEDITERRANEAN FRUIT FLY AND ITS APPLICATION TO FLY ERADICATION. p. 38-52 in "The Application of Nuclear Energy to Agriculture. Annual Report, 1 July 1963". Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica.

Egg and sperm sensitivities to γ-radiation were tested. Female pupae required 10 kr to ensure inhibited oviposition. This dose ensures almost 100% dominant lethals in all sperm, irrespective of pupal age. Tables show radiation effects (0, 1.25, 2.50, 5.00, 7.50, 10.00, 12.50 kr) on 7-, 8-, and 9-d pupae in terms of fertility, and a graph shows the percentage of dominant lethals induced in sperm at the 7-, 8-, and 9-d pupal stage. Radiation doses of 10 and 12 kr do not reduce longevity in irradiated adults. Doses > 20 kr were 100% lethal to pupae; 20 kr affect neither adult emergence nor longevity. Tables list radiation effects (0, 10.00 and 12.5 kr) on longevity of adults (male and female) and (for 0-90 kr, at 10 kr intervals) on adult emergence and longevity (applied at the 7-d pupal stage). From field tests adults do not appear to compete equally with normal males which are at least 3 times more agressive. Overflooding of a wild population would necessitate a $\geq 39:1$ (sterile : normal males) ratio. Dispersion and longevity studies were also carried out by tagging with P^{32}, following irradiation. "Trimedlure" was used in Steiner traps but appeals to males only. A recapture value of only 0.13% was obtained. For dispersal values, see 766.

1456 Moh, C.C. THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. ANNUAL REPORT. TID-18936, Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica. 1 July 1963. 62p.

Progress is reported in basic and applied agricultural research using nuclear energy as a tool. Tracer studies have yielded some information on dispersion and longevity of Ceratitis capitata Wied. under natural conditions. The flies were sterilized at different developmental stages, and their subsequent efficiency for eradication measures investigated. A list of publications for the period covered by the report is included.

Dacus (various species)

1457 Steiner, L.F., Mitchell, W.C., Baumhover, A.H. PROGRESS OF FRUIT-FLY CONTROL BY IRRADIATION STERILIZATION IN HAWAII AND THE MARIANAS ISLANDS. Int. J. appl. Rad. Isotopes 13 (1962) 427-34.

The course of experiments on Dacus cucurbitae Coq. (the melon fly), D. dorsalis Hendel (the oriental fruit fly) and Ceratitis capitata, Wied. (the Mediterranean fruit fly) is described. Factors which may affect successful application of the technique are discussed. Multiple mating (both sexes) occurs. Flight range is from 25-45 miles; sustained overwater flights of 12-42 miles have been observed. Fruit flies can now be reared in large numbers at reasonable costs. Irradiated flies tend to congregate in areas of greatest wild fly density. It is not necessary or economically feasible to separate sexes for release. Fly populations and fluctuations can be measured quickly throughout by powerful male lures. A genetic strain of white-marked oriental fruit flies is also being used to distinguish irradiated flies. Irradiation should be as low in the pupal period as possible. Dosages and cage tests are discussed. First field tests on medfly were partially successful. The Western pacific experiments, initiated in 1960, are discussed. Data on infestation by area of medfly larvae in different fruit after release of irradiated flies at Waikii are tabulated.

1458 Anonymous. ERADICATING THE MELON FLY. Agric. Res., Lond. 12, 2 (1963) 5.

The pest attacks cucurbits (melons, cucumbers, pumpkins, and related crops) as well as string beans and tomatoes. Before the first release of sterile Dacus cucurbitae, (Coq), the borders of producing farms were sprayed 3 times with bait sprays to reduce the wild fly populaltion by 90%, to lower the required flooding to manageable figures. In Sept. weekly releases of 4 - 10 million sterile flies were started, until a total of 180 million had been released. Within 3 weeks the sterile flies had flooded the native population by 13 : 1. By early December it was 50 : 1, by early January 100 : 1. Effective overflooding was considered to be > 10 : 1. Tests were carried out on Rota, a 33 square-mile island in the Mariana group, selected for its size and isolaltion (the nearest island, Guam, is 37 miles away).

Dacus oleae

1459 Melis, A., Baccetti, B. METODI DI LOTTA VECCHI E NUOVI SPERIMENTALI CONTRO I PRINCIPALI FITOFAGI DELL'OLIVO IN TOSCANA NEL 1960. (Old and new experimental methods aginst the principal phytophagous pests of the olive in Tuscany in 1960). Redia 45 (1960) 193-217. (In Italian, with English summary)

Various techniques are discussed. A series of experiments were carried out bearing on the application of the sterile-male technique. Prelininary results of using irradiated males of Dacus oleae on trees to depress female fecundity were promising. Pupae were irradiated, the most effective doses being from 8000 to 12 000 r γ-rays, the optimum period for irradiation being 7 to 3 d prior to adult emergence. Hence resulted sterile females and very active males which were able to copulate but did not allow normal females to lay fertile eggs. When the method was applied to isolated and confined plants, in the ratio of 4 irradiated males to every normal couple, the succeeding generation was effectively annihilated. Results were less satisfactory when only 3 irradiated males were used.

1460 Baccetti, B., Cappellini, M. RICERCHE SULLA STERILIZZAZIONE DI INSETTI NOCIVI CON RADIAZIONI IONIZZANTI. (Investigations on the sterilization of pernicious insects with ionizing radiations). Nuntius radiol. 27 (1961) 600-3. (In Italian, with English summary)

The olive fly, Dacus oleae Gmel., was subjected to high doses of γ- rays from Co^{60} at the pupal stage. After establishing the dose sufficient to make the males sterile without depriving them of their capacity of copulation, the ratio between irradiated and normal males necessary to obtain an almost complete sterilization of an environment infested with the olive fly was obtained.

1461 Melis, A. NUCLEAR ENERGY IN CONTROL OF Dacus oleae. Agricoltore Ital. 9, 4 (1963) 11-18.

II - B - 1 - c LEPIDOPTERA

II - B - 1 - c - i Lymantriidae
Thaumetopoea pithyocampa

1462 Baccetti, B., Zocchi, R. PROVE DI LOTTA CONTRO LA PROCESSIONARIA DEL PINO MEDIANTE L'USO DI RADIAZIONI IONIZZANTI. (Possible use of ionizing radiations against the pine processionary moth). Redia 47 (1962) 161 -8. (In Italian, with English summary)

The possibility of applying the sterile-male technique to the pine processionnary moth, Thaumetopoea pithyocampa Schiff. is examined. In laboratory experiments, males and females were sterilized by 4000 r γ- rays (Co^{60}-source), and the fecundity of normal couples was strongly depressed when sterile males were added in the ratio of 2 to every normal one. Irradiation needed to be carried out on the 15 d old chrysalis. As a sole means of control the technique appears to be impossible, theoretically, due to the difficulties of mass culturing T. pithyocampa in the laboratory of raising larvae on pine needles through many generations. The sterile-male technique would be worthwhile if integrated with biological control (the release of parasites emerged from collected nests).

II - B - 1 - c - ii Olethreutidae
Carpocapsa pomonella

1463 Proverbs, M.D., Newton, J.R. COULD THIS BE DEATH TO THE CODLING MOTH? AECL-1329, Atomic Energy of Canada, Ltd. Commercial Products Div., Ottawa. 1961.

See also 1464.
Originally published in Br. Columbia Orchardist 1, 4 (1960).

1464 Proverbs, M.D., Newton, J.R. COULD THIS BE DEATH TO THE CODLING MOTH? Gamma Irradiation in Canada 2 (1961) 13-4.

The possibility of using the sterile-male method to control Carpocapsa pomonella (L.) was investigated. Both females and males were found to mate more than once frequently. Gamma irradiation was found to be more consistent in the induced sterility results than growth at high temperatures. A high sterility was obtained when male pupae were exposed to 40 000 rad ~ 1 d before moth emergence, and normal behaviour is unaffected until > 50 000 rad is reached. About 2% of the eggs resulting from the union of such sterile males and normal females hatch, as compared with ~ 80% in the control. Irradiation was found to kill female pupae more readily than male pupae, and a dose of 25 000 rad sterilizes > 99% of the eggs that they lay.

1465 Proverbs, M.D. EFFECT OF GAMMA RAYS ON INSECTS. PROGRESS ON THE USE OF INDUCED SEXUAL STERILITY FOR THE CONTROL OF THE CODLING MOTH, Carpocapsa pomonella (L.) (LEPIDOPTERA: OLETHREUTIDAE). Proc. ent. Soc. Ont. 92 (1961) 5-11.

Heat treatments induced sterility or near-sterility but caused considerable mortality. Gamma irradiation was more successful. Exposure of mature male pupae or newly emerged male moths to 40 000 rads induced about 98% sterility without affecting adult emergence, mating, or adult longevity. Higher dosages decreased mating. Irradiation of eggs, mature larvae, or young pupae also resulted in a high degree of sterility, but caused undesirable effects. The female was more radiosensitive than the male. Mating of a normal female with an irradiated male (40 000 rads), either before or after a mating with a normal male, did not prevent the laying of mostly viable eggs. When irradiated males (mature pupae exposed to 30 000 rads) were caged with normal males and females, in the proportion of 10 : 1 : 1, the sex ratio of the offspring was 1 : 1 and both sexes were mostly fertile. In laboratory experiments in which (a) irradiated males, or (b) irradiated males and females were added to cages containing normal male and female moths, in the proportion of 10 irradiated moths of each sex to 1 normal male and 1 normal female, the deposition of viable eggs was reduced 98% in (a) and 66% in (b). In an orchard experiment (cages over dwarf trees) in which irradiated males (mature pupae exposed to 40 000 rads) were caged with normal males and females, in the proportion of 10 : 1 : 1, the number of moths in the F_1 generation was reduced to approximately 1/3 of the number of normal moths in the parental generation. (Auth.).

1466 Proverbs, M.D. CONTROL OF THE CODLING MOTH, Carpocapsa pomonella (L.) BY THE RELEASE OF SEXUALLY STERILE MALES. p. 36 in "Radiation Biology in Canada 1962-63". CRB-1129, AECL-1701, Atomic Energy of Canada Ltd., Chalk River, Ont. Feb. 1963.

The release of sterile males (see 809) into the environment has given some promising preliminary results.

1467 Marshall, J. CAN WE ERADICATE THE CODLING MOTH? West. Fruit Gr. 17, 4 (1963) 19-20.

Popular presentation of the possibilities of applying the sterile male technique to Carpocapsa pomonella (L.).

II-B-1-c-iii Phycitidae
Anagasta (Ephestia) kühniella
Paramyelois transitella

1468 Brande, J. van den, Pelerents, C. QUELQUES EFFETS DES RAYONS GAMMA SUR LA TEIGNE DE LA FARINE ET SUR DIVERS NÉMATODES. C.R. Rech., Brux. 1, 28 (1962) 11-47.

Les auteurs traitent la biologie et l'élevage de la teigne de la farine, Ephestia kühniella Zell., et donnent quelques résultats d'essais d'irradiation sur œuf, chenille et chrysalide. La stérilisation des mâles a été obtenue par irradiation des chrysalides adultes (15 j) avec une dose de 60 000 rad. Le nombre d'œufs stériles augmente assez régulièrement avec le nombre de mâles stériles. En réalité, le pourcentage observé est partout inférieur à celui attendu. La nécessité de certaines améliorations dans la technique est indiquée. - Plusieurs essais ont été réalisés sur d'autres insectes (Leptinotarsa decemlineata, Cacoecia rosana, Chortophila brassicae, Apis mellifera). Pour chaque insecte les doses létales et mutagènes diffèrent fortement, sans la moindre possibilité d'extrapolation. (En outre, une reine des abeilles a été marquée d'un fil d'argent 110). - Trois catégories de nématodes ont été étudiées: les nématodes libres, les nématodes des racines noueuses et les nématodes à kystes. Dans les nématodes de racines noueuses, Meloidogyne hapla Chitwood, l'infection ne diminue fortement qu'à partir de 160 000 rad. Sur le nématode doré de la pomme de terre, Heterodera rostochiensis Woll. les doses < 40 000 rad n'ont aucun effet. Une forte diminution est à observer à partir de 80 000 rad tandis que 320 000 rad préviennent toute infection.

1469 Bull, J.O., Wond, T. CONTROL OF THE MEDITERRANEAN FLOUR MOTH Anagasta kühniella ZELL. BY STERILE MALE RELEASE. I. BIOLOGICAL STUDIES RELATED TO LARGE SCALE REARING. AERE-R-3895, United Kngdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1962. 16p.

The longevity, fecundity, viability and mating behaviour of a laboratory strain of A. kühniella was determined. The strain was used to rear large numbers of the species. Females laid an average of 243 eggs, most being laid 2-3 d after the beginning of oviposition. The egg viability was 90%, of which 95% hatched in 5 d. Optimum rearing conditions are represented by inoculation of English coarse wholemeal flour at a density of 5000 eggs/kg, and incubation at 25°C. Production of the millions of insects required for sterile male release is easily achieved.

1470 Husseiny, M.M. STERILIZATION BY GAMMA RAYS FOR THE CONTROL OF THE NAVEL ORANGEWORM. (Abstr. 273). Bull. Ent. Soc. Amer. 8, 3 (1962) 166.

Laboratory tests to determine the possibility of controlling the navel orangeworm, Paramyelois transitella (Walker), by gamma irradiation were very promising, especially when both sterile males and females were used. Sterile but sexually active males and females were obtained by subjecting mature pupae to 50 000 rads of gamma irradiation.

1471 Husseiny, M.M. STERILIZATION BY GAMMA RADIATION FOR THE CONTROL OF THE NAVEL ORANGEWORM Paramyelois transitella (Walker) (LEPIDOPTERA: PHYCITIDAE). Diss. Abstr. 24, 4 (1963) 1758-9.

The insect is becoming an increasingly important pest of almond and walnut in California. A simple and economical method of mass rearing was accomplished in the summer of 1961, the main difficulty having been mating habits in the laboratory. Mating could be improved considerably by providing indirect air circulation, high relative humidity, cool temperature, preferably between 10-16°C, and light intensity similar to conditions prevailing in the early morning. A Co^{60}-unit gave ~ 197 500 rads/h. Mature pupae (8 d old) were the most desirable stage to irradiate without causing appreciable damage to the insect, and was also the stage most convenient to handle and sex. At a dosage of 160 000 rads no adults emerged. At 80 000 rads, > 50% of both males and females were still able to mate but reduction in egg laying was considerable in the case of irradiated females. Complete sterility was obtained in both sexes when mature pupae were exposed to 50 000 rads. Longevity, egg laying, and mating habits did not seem to be affected at this dose. No effect on fertility was detected after 20 000 rads or less but drastic reduction in fertility was obtained at 30 000 and 40 000 rads. Eggs were more susceptible to radiation damage than mature larvae and the latter stage more so than mature pupae. Much better results may be obtained by using both sterile males and females for control and eradication. Most females were shown to mate but once in the field, only 8% mated twice.

1472 Madsen, H.F. PROGRESS REPORT ON THE NAVEL ORANGEWORM, MALE STERILIZATION PROJECT. Diamond Walnut News 45, 6 (1963) 12-13.

II-B-1-c-iv Pyraustidae
Pyrausta nubilalis

1473 Springell, P.H. IRRADIATION, A STERILIZATION WEAPON AGAINST THE CORN BORER. Agric. Res. 12, 3 (1963) 6.

Adult males of Pyrausta nubilalis were sterilized by doses of 32 000 r 1 d after emergence. Only 1% or less of the eggs hatched when sterile males were mated with untreated females, 40% eclosion for 66% irradiated males. Sterility did not affect competitiveness for females, nor was longevity affected. Irradiation as pupae affected egg hatch, depending on age of pupa at time of irradiation, the younger pupae being more susceptible. Fertility decreased with increasing radiation dosage for both sexes, but female pupae were more susceptible. Deformity up to 50% occured in pupae irradiated with 5000 r at under 24 h. At 48 h deformity was avoided.

II-B-1-c-v Cloridea obsoleta

1474 Андреев, С.В., Самойлова, З.И., Иванский, Н.Л., Мартенс, Б.К. ВОЗМОЖНОСТИ ИСПОЛЬЗОВАНИЯ ГАММА-ИЗЛУЧЕНИЙ ДЛЯ ПОЛОВОЙ СТЕРИЛИЗАЦИИ НАСЕКОМЫХ КАК МЕТОДА БОРЬБЫ С ВРЕДИТЕЛЯМИ СЕЛЬСКОХОЗЯЙСТВЕННЫХ КУЛЬТУР. Стр. 19-20 в сб. "Материалы Симпозиума по применению биофизики в области защиты растений". Л. 1961. Р. Ж. Биол. №18Ж326. 1962.

Andreev, S.V., Samoĭlova, Z.I., Ivanskiĭ, N.L., Martens, B.K. POSSIBILITIES OF USING GAMMA RADIATION FOR SEXUAL STERILIZATION AS A METHOD OF CONTROLLING PESTS OF AGRICULTURAL CROPS. p.19-20 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961. R. Zh. Biol. No. 18Zh326. 1962.

The biophysics laboratory of the All Union Research Institute of Plant Protection and the Azerbaidzhan Plant Protection Station are investigating the effect of gamma irradiation of male pupae of Chloridea obsoleta on moth sterilization. Co^{60} is used as the source of radiation. Based on results of laboratory tests (paired placement of irradiated moth males with untreated females), the sterilizing dosage of γ-radiation for pupae of C. obsoleta is approximately 8000 to 10 000 r. Procedures are being developed for mass propagation of Chortophila brassicae to obtain pupae for sterilization and liberation of sterile individuals. (BA 43: 1963, 20898).

1475 Андреев, С.В., Самойлова, З.И., Мартенс, Б.К., Иванский, Н.Л. ГАММА-ИЗЛУЧЕНИЯ И БОРЬБА С НАСЕКОМЫМИ. Защ. Раст. 9 (1962) 25-6. Р. Ж. Биол. №6Е212.1963.

Andreev, S.V., Samoĭlova, Z.I., Martens, B.K., Ivanskiĭ, N.L. GAMMA IRRADIATION IN THE CONTROL OF INSECTS. Zashch. Rast. 9 (1962) 25-6. R. Zh. Biol. No. 6E212. 1963.

Pupae of male Chloridea obsoleta were subjected to Co^{60} radiation in doses of 4000 to 15 000 r during exposures of 7 min or longer. Doses of 8000 r produced total sexual sterility in males. Females mating with the irradiated males deposited smaller quantities of eggs which were infertile. (BA 45: 1964, 30747).

II-B-2 CONTROL BY INDUCED GENETIC CHANGES

1476 Borstel, R.C. von., Buzzati-Traverso, A.A. ON THE ROLE OF LETHAL MUTANTS IN THE CONTROL OF POPULATIONS. p.273-8 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Since radiation induces dominant lethal mutations in sperm, it can be shown that monogamy is not requisite for eradicating a population through the introduction of irradiated males. An outline is presented for experimental analysis of population collapse by the irradiation-of-male method where females mate more than once. Possible effects on populations of release of males containing recessive lethal mutations or mutations for female sterility are briefly discussed, the possibility of genetic induction of population extinction is explored.

1477 LaChance, L.E., Knipling, E.F. CONTROL OF INSECT POPULATIONS THROUGH GENETIC MANIPULATIONS. Ann. ent. Soc. Amer. 55, 5 (1962) 515-20.

Calculations are presented that support the feasibility of using insects, with inherited lethal factors to control their own populations. The boll weevil, Anthonomus grandis Boheman, is used as an example, and the theoretical results of releasing males carrying recessive lethal genes into a natural population suggest that this method of control may prove valuable. (Auth).

II-B-3 OVERLOADING RESOURCES

1478 Monro, J. POPULATION CONTROL IN ANIMALS BY OVERLOADING RESOURCES WITH STERILE ANIMALS. Science 140 (1963) 496-7.

Sterile animals might be introduced into a population to overload a resource. As a result, some of the original fertile animals might be lost by migration or death. This process could be repeated until the fertile population was eradicated without the mating required by Knipling's models. This method may be of use in ecology and in economic control of populations. A hypothetical example is given. If flushing is considered for use against pests, the resource to be overloaded should be carefully chosen in order to minimize the total damage done by sterile and wild animals during attempted eradication or control.

II-C Infestation and Countermeasures

II-C-1 STORED PRODUCTS

1479 Cornwell, P.B., Burson, D.M., Pendlebury, J.B., Martin, V.J., Bull, J.O. CONTROL OF WEEVIL POPULATIONS Sitophilus granarius L. WITH STERILISING AND SUBSTERILISING DOSES OF GAMMA RADIATION. AERE-R-3892, United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England. 1962. 37p.

The efficacy of 16 000 rads, recommended for industrial applications of γ-radiation for the control of insects in grain, is substantiated by the complete sterilisation and death of 10 million insects of a wild strain of S. granarius under conditions simulalting bulk storage. Sub-sterilising doses of 10 000 to 14 500 rads suppress weevil populations to a very low level and prevent their increase for 4-8 months; this period of "short-term" control is related to the size of the population and O_2-tension at irradiation. The reproductive potential of fertile and sub-fertile grain weevils is depressed when added to large irradiated populations, partial protection to the grain against re-infestation is afforded by the insemination of contaminants with sterile sperm which remains competitive within the female and with fertile sperm subsequently inseminated, for periods > 4 months. A reduction in reproductive potential of weevils which may be underdosed at irradiation gives considerable flexibility to the requirement of dose uniformity in plant design for disinfestation of grain. (Essentially auth).

1480 Cotton, R. T. THE POTENT FORCE OF RADIANT ENERGY. Northw. Miller 265, 7 (1961) 38, 40, 42-3.

"Its use to destroy and control pests in stored grain and milled cereal products remains highly experimental, but recent progress merits review." The author briefly reviews latest developments in the field of insect control, the possible uses of radiant energy commercially, and the limitations governing its use.

1481 Papadopoulou, C.P. DISINFESTATION OF DRIED FIGS BY GAMMA RADIATION. p.485-90 in "Radiation and Radioisotopes applied to insects of agricultural importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Preliminary experiments indicate that disinfestation of figs by γ-radiation is a promising treatment since, at the moderate doses of 100-200 krad needed for the destruction of the different stages of the infesting insects, no significant changes result in the texture, appearance and nutritive value (related to carbohydrates) of the figs. The following species were studied: Plodia interpunctella, Ephestia cautella, Carpophilus hemipterous, Gryzaephilus surinamensis and Lasioderma serricorne. In general, doses < 25 krad do not affect hatching of eggs, above it the reduction varies with the species, and no hatching is observed at 100 krad. The time required for 50% of an irradiated larva population to die was 2-3 d at 100 krad and 1 d at 250 krad. In general there was no eclosion of pupae with ≥ 50 krad. At a dose of 400 krad all insects were killed in < 48 h.

1482 Расулов, Ф.К., Анастасьев, С.А. БОРБА С ВРЕДИТЕЛЯМИ ЗАПАСОВ ГАММА-РАДИАЦИЕЙ. Вестн. с.-х. Науки 9 (1963) 34-5.

Rasulov, F.K., Anastasiev, S.A. THE CONTROL OF WAREHOUSE PESTS BY GAMMA RADIATION. Vestn. sel'skokh. Nauki 9 (1963) 34-5.

Gamma irradiation of technical seed and feed stuffs at the rate of 20 000, 25 000 and 30 000 rep resulted in 100% control of the granary and rice weevils, meal beetles, grain borers and confused flour beetles (Calandra granaria, C. oryzae, Silvanus surinamensis, Laemophloens testaceus, Stegobium paniceum and Tribolim confusum).

1483* Török, G., Farkas, J. A RAKTÁRI ROVARKÁRTEVÖK ELLENI VEDEKEZÉS NÉPGAZDASÁGI JELENTÖSÉGE ÉS A ROVARTALANÍTÁS ÚJ LEHETÖSÉGE: AZ IONIZÁLÓ BESUGÁRSÁS. (The importance of exterminating insects in warehouses from the viewpoint of national economy, and a new way of insect control: ionizing radiation). Élelmezési Ipar 14, 7 (1960) 199-206. (In Hungarian, with English summary).

Review article. The extent of the damage to stored products caused by insects is analyzed statistically, and the most frequently occurring insects discussed. After reviewing the known effects of ionizing radiations on insects their possible application in the food industry for insect eradication is considered. Attention is paid to the economic aspects involved.

See also:

765 Effects on subsequent generations after γ-irradiation of larvae of Lyctus brunneus (Steph.) (Coleoptera, Lyctidae). (Bletchly, 1962).

768 A comparison of the susceptibility of the grain weevil (Sitophilus granarius L.) to accelerated electrons and Co^{60} gamma radiation. (Bull et al., 1961)

790 Influence de l'irradiation sur les adultes de Sitophilus sasakii Takahashi (Curculionidae) et leurs descendants. (Laviolette and Nardon, 1963).

791 Action des rayons γ du cobalt-60 sur la mortalité et la fertilité des adultes d'un charançon du riz. (Laviolette and Nardon, 1963).

805 Some effects of gamma radiation on the lesser grain borer (Rhizopertha dominica F.), tropical warehouse moth (Cadra (Ephestia) cautella Wlk.), Indian meal moth (Plodia interpunctella Hübn.), and the cigarette beetle (Lasioderma serricorne F.).

806 La protection des denrées contre les insectes ravageurs par l'emploi des radiations ionisantes en vue d'obtenir la stérilité des insectes adultes. Etude particulière de la réaction des gonades de "Sitophilus granarius". (Pesson and Vernier, 1963).

1103 The influence of temperature upon the radiation susceptibility of Sitophilus granarius L. (Pendlebury et al., 1962).

1228 The susceptibilitiy of the confused flour beetle (Tribolium confusum Duv.) to gamma radiation. (Banham, 1962).

1236 Effect of radiation on Mexican fruit-fly eggs and larvae in grape-fruit. (Brownell and Yudelovitch, 1962).

1363 The effects of continuous and fractionated doses of gamma-radiation on the survival and fertility of Sitophilus granarius (Calandra granaria L.). (Jefferies, 1962).

1364 The effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (Calandra granaria) L. (Jefferies and Banham, 1961).

1498 Some experimental data on cobalt 60 radiation doses capable of arresting insect infestation of cereals and flour. (Pesson, 1963).

1499 Utilisation des radiations ionisantes (^{60}Co) pour la protection des denrées contre les insectes nuisibles. Recherches relatives à la détermination des doses utiles pour assurer la stérilité des insectes. (Pesson, 1963).

1500 Radiation preservation of grapes and some other Greek fruits. (Saravacos and Macris, 1963).

1526 The life history and behavior of an internal feeding stored grain insect, Rhizopertha dominica (Fab.), by use of x-ray. (Stemley, 1962).

1528 On the advantage of the x-ray examination of certain classes of materials for insects subject to plant quarantine regulations. (Yuasa, 1962).

1580 Travaux de recherches utilisant les isotopes et les rayonnements nucléaires en entomologie appliquée en France et dans les pays associés. (Pesson, 1962).

II-C-2 DISINFESTATION MEASURES

(Sources. Conveyor Systems. Etc.)

1484 Anonymous. RADIATION DISINFESTATION OF GRAIN. Int. atom. Energy Ag. Bull. 4, 4 (1962) 18-20.

The process can be automated and operated safely. Electron accelerators and cobalt sources could be used for all the throughput rates utilized in most conventional grain handling installations. The experts recommended that, for a pilot plant study, electrical machines with electron energy in the range of 2-4 MeV to achieve uniformity of dose deposition and simplicity of grain handling for the throughput rate of 100-200 t of grain/h be used. For the throughput rate of 20-40 t/h, they recommended Co^{60} sources, with which it is possible to achieve a radiation efficiency of 50-70%. (Auth).

1485 Anonymous. GAMMA RADIATION AS A MEANS OF INSECT CONTROL IN WHEAT AND WHEAT PRODUCTS. Appl. Atomics 413 (1963) 11-12.

The U.S. Food and Drug Administration (FDA) officially approved the use of γ-rays for insect control in wheat, according to a plan elaborated by L.E. Brownell. Co^{60} is used for sterilizing insect eggs in the wheat. The road should now be clear for the construction of a prototype plant capable of handling 200 tons/h of wheat, possibly in India.

1486 Bletchly, J.D. EFFECT OF GAMMA RADIATION ON SOME WOOD-BORING INSECTS. Ann. appl. Biol. 49 (1961) 362-70.

Studies have been made on the effects of γ-radiation on eggs, larvae, pupae and adults. Oviposition was obtained on suitable egg-laying blocks-oak sapwood veneers for Lyctus planicollis Lec. (Bletchly, 1960), Corsican or Scots pine sapwood blocks with muslin surfaces for Anobium punctatum Deg. (Bletchly, 1952) and decayed oak sapwood for Xestobium rufovillosum Deg. Larvae were either irradiated free (Lyctus) or within oak sapwood blocks (Lyctus), or pine (Anobium) or decayed oak sapwood (Xestobium). Pupae were treated free (Anobium) or within decayed oak sapwood (Xestobium); adults were irradiated free or within infested wood. For studies on subsequent fertility and viability of eggs, treated pupae and immature and mature adults were provided with egg-laying blocks. In addition naturally infested material has been treated. Co^{60} sources giving dose rates from 50 to 1300 r/min have been used as well as higher rates. A dosage of about 10 000 r is required to prevent completion of development or to produce sterile adults, although further information is required on the survival of larvae hatching from irradiated eggs. An additional safety margin would be desirable plus a further correction to allow for attenuation in the timber. The higher fertility exhibited when an individual of one sex is irradiated and mated to an untreated beetle of the opposite sex is somewhat academic, since both sexes would normally be irradiated simultaneously. Nevertheless, when 100% control is not achieved, this factor represents an additional risk with regard to re-infestation of susceptible wood. The use of radioactive substances for eradication and preservation is not feasible due to the mechanical difficulties involved in providing adequate shielding.

1487 Brookhaven National Lab., Upton, N.Y. and Vitro Engineering Co., New York. STUDY REPORT. COBALT-60 BULK GRAIN IRRADIATOR. BNL-810 (T-312). 30 June 1963. 37p.

Results are presented of a study to conceive, evaluate, review and estimate costs for a number of suitable designs for a Co^{60} Bulk Grain Irradiator; select a preferred type; and establish required criteria for future detail design and construction of the selected concept. Three irradiator concepts are described. The irradiators discussed are sized to function as a pilot plant in an agricultural experiment station. Particular attention is given to scale-up capability, so that the same performance characteristics can be obtained for commercial utilization, without penalty to the usefulness of the irradiator as an experimental tool. A single concept, designated as the continuous-grid source concept, is selected as most promising because of its high efficiency, exceptional versatility, acceptable cost, ease of maintenance, good reliability and inherent simplicity. For the purposes of this study it has been assumed that a dose of 15 000 – 25 000 rads should be used giving a max./min. dose ratio of 1.66. Scaling up of throughput was not to cause any basic change in this ratio. The immediate objective of the study was to develop criteria and concepts for a pilot plant with a through-put of 5000 lb/h. An economic study was also made.

1488 Brownell, L.E., Horne, T., Kretlow, W.J. PETITION FOR THE USE OF GAMMA RADIATION TO PROCESS WHEAT AND WHEAT PRODUCTS FOR THE CONTROL OF INSECT INFESTATION.* NP-13640, Michigan. Univ., Ann Arbor and Curtiss-Wright Corp., Princeton, N.J., July 1962. 162p.

Applications of γ-radiation in the processing of wheat and wheat products for the control of insect infestation are discussed. Data are presented from studies of radiation dose necessary for insect control and the effect of these doses on the physical properties, nutritional value, and wholesomeness of wheat and wheat products. Results are summarized from feeding studies using rats and dogs. Methods are outlined for the radiation processing of wheat and wheat products, irradiation facilities are described, and an estimate on cost factors is included. 55 references. (NSA 18: 1964, 13446).

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* Compiler's note: Not available to the general public. But see 1489.

1489 Brownell, L.E. GAMMA RADIATION FROM SOURCES WITH MAXIMUM ENERGY NOT TO EXCEED 2.2 MILLION ELECTRON VOLTS, TO PROVIDE AN ABSORBED DOSE FROM 20 000 TO 50 000 rads MAY BE SAFELY USED FOR THE IRRADIATION OF WHEAT AND WHEAT PRODUCTS FOR CONTROL OF INSECT INFESTATION. Federal Register, 21 Aug. 1963. 28 FR 9208. Washington, D.C., Government Printing Office.

1490 Brownell, L.E. THE POTENTIAL VALUE OF GAMMA RADIATION IN THE WHEAT INDUSTRY. 34p. in "Second National Conference on Wheat Utilization Research, United States Department of Agriculture, 28-30 October 1963". Peoria, Illinois.

On Aug. 15, 1963 the Food and Drug Administration approved the use of γ-radiation to process wheat and wheat products for the control of insect infestation. Exhaustive tests to check the wholesomeness of irradiated wheat were carried out at the University of Michigan. A dose of 20 000 rad was used on a mixture of soft white wheat and winter durum, exposed to a Co^{60} source with a γ-flux of 180 000 rep h, after storage at room temperature for 1-3 months. Adverse storage conditions (80-90°F for 6 months) on the nutritional values of irradiated wheat were also tested. Groups of 12 male and 20 female Holtzman-strain albino rats were used. Irradiated wheat fed to rats for 9 months or more had no effect on growth, reproduction or pathology. Lower and upper dosage limits for irradiating wheat commercially were specified as 20 000 rad (for breaking the reproductive cycle of the infesting insect) and 50 000 rad. No detrimental effects of the upper dose have been observed on nutritional value, wholesomeness and quality. Costs of preparing and operating a grain ship are tabulated. For a single treatment the use of γ-radiation will be more expensive than the use of fumigants. If more than 2 fumigations are required during storage the irradiation could be the more economical, as a single irradiation will suffice if the treated grain is protected against reinfestation (insect-proof cartons, bags with specially treated surfaces cans, jars) Co^{60} will probably be more economical than Cs^{132}as a γ-source if the period of amortization is $\leq$ 5 years. The geometry of the source is an important consideration in obtaining efficient use of the radiation sources and in keeping the dosage range between 20 000 and 50 000 rads. The gravity flow irradiator with a matrix of rod sources has an advantage for processing loose grain, the simulated plaque source for bagged wheat and packaged wheat products. If the irradiation capacity is seasonal and varies widely, such as 4 to 200 tons/h, mobile irradiators may be used in numbers sufficient to meet the demand. Mobile irradiators would consist of 130 elements at 6000 c, each capable of treating 9-10 000 tons of grain/week or 80 tons/h on a 120 h/week operation. Irradiators could be used on shipboard to treat grain on entry through a seaport. For continuous processing at fairly uniform rates, permanent irradiators would be preferred, possibly using the gravity flow design for loose grain and a bucket conveyor for bagged grain and packaged wheat products.

1491 Deschreider, A.R. RESEARCH IN GAMMA IRRADIATION OF WHEAT FLOUR. Conserva, The Hague 10, (1961-2) 115-7. (In Dutch). English Translation: AEC-tr-5773. 9p.

Irradiation of wheat flour and cereal products with doses of Co^{60} γ-radiation between 25 and 150 kilorad resulted in destruction of insect pests in all stages of development. Exposure of flour to doses between 25 and 150 kilorad improved the baking quality of wheat flour, and doses of 500 to 1000 kilorad improved the storage life of unrefrigerated pre-baked or partially-baked packaged products. Results are reported from studies of the chemical effects of γ-radiation on the proteins, enzymes, and other constituents of wheat flours. (NSA 17: 1963, 21960).

1492 Dietz, G.R. DEVELOPMENT OF IRRADIATION FACILITIES. p.135-54 in "Radiation Pasteurization of Foods". Summaries of Accomplishment. TID-7684, Division of Isotopes Development and Division of Biology and Medicine, AEC. 1963.

A major portion of the AEC food irradiation program is devoted to the development of a family of radiation facilities. First, research irradiators capable of supporting food irradiation studies were designed and constructed. Current emphasis is on proto-commercial facilities either under design or construction, or planned for construction as the program develops. Proto-commercial facilities are intended to translate laboratory data to semi-production or pilot plant operation to prove laboratory data on a near commercial scale, and to aid in the determination of the economics involved. Included in this category are mobile units, a Marine Products Development Irradiator (MPDI), and a grain irradiator. Types of irradiators classed as highly specialized, or applicable in unique situations, constitute another category. Detailed discussion is presented on a research irradiator, transportable units, the grain irradiator, central or inplant irradiators such as the MPDI, on-board ship irradiators, the Hawaiian irradiator, and the U.S. Army Radiation Laboratory at Natick, Massachusetts. (NSA 18: 1964, 22201).

1493 Harvey, J.M. IRRADIATION OF FRUITS AND VEGETABLES IN A MOBILE COBALT 60 UNIT. p.55-7 in "Radiation Pasteurization of Foods". Summaries of Accomplishment. TID-7684, Division of Isotopes Development and Division of Biology and Medicine, AEC. 1963.

A mobile Co^{60} unit containing 40 000 c is described. A typical dose of 200 000 rad requires a dwell time of 40 min. Several fruits, vegetables, and insects have been treated with the unit; work done with insects is described at some length. About 120 insects at each stage of development were treated with 7 dosages, and 5 replications were available in each experiment. Findings indicate variations in radiosensitivity of the various species studied, the most sensitive being Tribolium confusum which requires < 10 000 rad for a sterilizing dose (one which will disrupt the life cycle). The cigarette beetle, Lasioderma serricorne, the black carpet beetle, Attagenus piceus, and Trogoderma beetle were found to be intermediate in susceptibility (< 15 000 rad); The Indian meal moth, Plodia interpunctella, was comparatively resistant, requiring 50 000 rad for a sterilizing dose. In general, the older a specimen was in each stage of development, the less susceptible it proved to irradiation.

1494 Horne, T. "THE GRAIN SHIP: A PROPOSAL FOR INCREASING THE WORLD FOOD SUPPLY". Princeton, N.J., Curtiss-Wright Corporation. 1961.

An irradiator on board ship allows disinfestation measures to be applied to grain in widely different locations, the advantages involved in this greater mobility being numerous. The design, potentialities and economics are discussed.

1495 Крейцберг, В.Е. КАРАНТИННАЯ ДЕЗИНСЕКЦИЯ ПРОТИВ ПЛОДОВЫХ МУХ. Защ. Раст. 11 (1961) 49-52. Р. Ж. Биол. №13Ж247. 1962.

Kreitsberg, V.E. QUARANTINE DISINFESTATION FROM FRUIT FLIES. Zashch. Rast. 11 (1961) 49-52. R. Zh. Biol. No. 13 Zh 247. 1962.

Imported oranges and tangerines in the USSR are disinfested against fruit flies by only one method; refrigeration for 3 weeks at temperatures of 0-1.5°C. Descriptions are given of 5 physical and 5 chemical methods of disinfestation used abroad. These methods may find application in the USSR. Small shipments of fruits and vegetables crossing the border can be treated with x-rays with a portable apparatus. The refrigeration of imported fruits must be accomplished primarily en route, while non-refrigerated produce can be treated in several ways: fruits for immediate sale with warm saturated steam, dibromomethane, ethylenechlorobromide, and methylbromide; products for prolonged storage with refrigeration. Severely infested fruit, especially in the period of the emergence of the larvae, must be quickly frozen. (BA 41: 1963, 20582).

1496 Kuhl, O.A. IRRADIATOR DESIGN STUDIES AT BROOKHAVEN NATIONAL LABORATORY. p.81-2 in "Radiation Pasteurization of Foods". Summaries of Accomplishment. TID-7684, Division of Isotopes Development and Division of Biology and Medicine, AEC. 1963.

During the past year conceptual design studies for a Bulk Grain Irradiator and a Shipboard Marine Products Irradiator were carried out and reported in BNL 810 (T-312) and BNL 808 (T-311), respectively. Specifications are presented for both irradiators. (Auth).

1497 Nardon, P. LES POSSIBILITÉS D'EMPLOI DES RADIATIONS DANS LA LUTTE CONTRE LES INSECTES. Phytoma 144 (1963) 7-12.

Les adultes de Sitophilus sasakii Takahashi sont exposés aux rayons γ (^{60}Co) en présence de blé. Le seuil de sensibilité se situe à 5000 r pour les mâles, et entre 6000 et 8000 r pour les femelles. Dès 8000 r, les insectes sont anéantis en une dizaine de jours. L'examen des courbes de mortalité à différentes doses montre que celle-ci apparaît brusquement après une phase de latence d'autant moins longue que la dose est plus élevée. Pendant cette période, les insectes continuent à se nourrir. (Les espèces voisines (S. granarius et S. oryzae) ont une sensibilité tout à fait comparable.) 2000 r réduisent la fertilité de plus de la moitié. L'augmentation de la dose entraîne une inhibition supplémentaire de la fertilité. A 5000 r apparaît une phase de stérilité temporaire du 7e au 12e jour. Elle s'étend avec une dose plus élevée. A 15 000 r la stérilisation est totale. On peut donc stériliser et tuer assez facilement les charançons du blé. Le reste de la communication concerne la technique d'application, des résultats obtenus ailleurs avec des mâles stériles dans la lutte biologique contre Callitroga hominivorax, Musca domestica, Dacus et Ceratitis, Ephestia kühniella, Carpocapsa, et Anthonomus grandis.

1498 Pesson, P. SOME EXPERIMENTAL DATA ON COBALT 60 RADIATION DOSES CAPABLE OF ARRESTING INSECT INFESTATION OF CEREALS AND FLOUR. Food Irrad. 3, 4 (1963) A18-A21.

The study was aimed at determining the minimum effective doses of γ-radiation required to stop either the development of eggs or the larval stages, or to sterilize adult insects. The following insects, commonly found in cereals and flour, were investigated: Sitophilus (Calandra) granarius L., Sitophilus oryzae L., Tribolium confusum J. du V., Tenebrio molitor L., Gnathocerus cornutus F., Rhizopertha dominica Ol, Acanthoscelides obsoletus Say, Ephestia kühniella Zell, and Sitotroga cerealella Ol. The effective minimum doses were found to vary with the species: Sitophilus granarius required 10 000 rads, Tribolium > 12 000 rads, larvae of Tenebrio - 8000 rads; Gnathocerus - 8000 rads; Rhizopertha - 12 000 rads, Acanthoscelides obsoletus - 20 000 rads; Ephestia - 16 000 rads. In general, 20 000 rads appears to be the minimum effective dose capable of arresting larval development or reproduction of all the species studied.

1499 Pesson, P. UTILISATION DES RADIATIONS IONISANTES (^{60}Co) POUR LA PROTECTION DES DENRÉES CONTRE LES INSECTES NUISIBLES. RECHERCHES RELATIVES A LA DÉTERMINATION DES DOSES UTILES POUR ASSURER LA STERILITÉ DES INSECTES. Industr. agric. 80, 3 (1963) 211-25.

Les doses stérilisantes, appliquées soit sur les stades larvaires soit sur les stades imaginaux, sont généralement d'un ordre de grandeur très voisin des doses létales. Un autre effet très général est le retard observé dans le développement larvaire ou nymphal. Les doses minima utiles relevées sont de 8000 rad pour Gnathocerus cornutus et les larves de Tenebrio molitor, de 10 000 rad pour les Calandres, 12 000 rad pour Rhizopertha et un supérieur à 12 000 rad pour Tribolium, de 16 000 rad pour Ephestia et de 20 000 rad pour la Bruche du haricot. En tenant compte des espèces les moins sensibles et de leurs stades les plus résistants, on peut considérer que des doses de 20 000 rad doivent donner une sécurité générale contre tous ces insectes susceptibles de s'installer et de pulluler dans les denrées (farines ou grains). Ces doses ne doivent pas produire des inconvénients secondaires (changements des caractères organoleptiques et des qualités nutritionelles). L'efficacité générale satisfaisante de doses de l'ordre de 20 000 rad, pour assurer l'extinction des populations d'insectes ayant contaminé un produit, doit faciliter la mise au point de techniques permettant un traitement plus rapide sans avoir à disposer de sources de radiations particulièrement puissantes. Dans le domaine de la protection des céréales stockées, en particulier, cela peut avoir un intérêt primordial.

1500 Saravacos, G., Macris, B. RADIATION PRESERVATION OF GRAPES AND SOME OTHER GREEK FRUITS. Food Irrad. 4, 1-2 (1963) A19-A21.

Preliminary results on the disinfestation of dried figs have shown no significant changes in sugars (total and reducing) up to doses of 500 000 rad. The colour of the irradiated figs was not affected by γ-radiation at these doses. The radioresistance of certain species of insects which attack stored dried figs is reported under investigation.

1501 Schmidt, H. DIE WIRKUNG VON RÖNTGENSTRAHLEN AUF HOLZZERSTÖRENDE INSEKTEN. (The effect of x-rays on wood-destroying insects). Holzforschung 13, 1 (1961) 8-11. (In German)

The kind of radiation doses tolerated by larvae of Hylotrupes bajulus L. and working termites of Reticulitermes were investigated and, following on from that, the suitability of x-rays for combating the pests. Soft x-rays were found to be effective on insects when outside the wood. In view of the very high lethal dose required even then (~ 200 000 r for Hylotrupes and ~ 100 000 r for termites) and of the great protection afforded to them once the insects are inside the wood, there is no chance of applying x-rays for fighting the insects.

See also:

1484 Radiation disinfestation of grain. (Anonymous, 1962).
1485 Gamma radiation as a means of insect control in wheat and wheat products. (Anonymous, 1963).
1487 Study report. Cobalt-60 bulk grain irradiator. (Brookhaven National Lab., Upton, N.Y. and Vitro Engineering Co., New York, 1963).
1488 Petition for the use of gamma radiation to process wheat and wheat products for the control of insect infestation. (Brownell et al., 1962).
1489 Gamma radiation from sources with maximum energy not to exceed 2.2 million electron volts, to provide an absorbed dose from 20 000 to 50 000 rads may be safely used for the irradiation of wheat and wheat products for control of insect infestation. (Brownell, 1963).
1490 The potential value of gamma radiation in the wheat industry. (Brownell, 1963).
1492 Development of irradiation facilities. (Dietz, 1963).
1494 "The Grain Ship: A Proposal for Increasing the Worl Food Supply". (Horne, 1961).
1495 Quarantine disinfestation from fruit flies. (Kreitsberg, 1962).
1496 Irradiator design studies at Brookhaven National Laboratory. (Kuhl, 1963).
1583 Present status and the future development of radiotechnology. (Stanković, 1962).

II-C-3 ECONOMICS

1502 Cornwell, P.B. INSECT CONTROL BY GAMMA IRRADIATION - A TECHNICALLY FEASIBLE PROCESS, BUT IS IT DESIRABLE AND CAN IT BE APPLIED? Food Irrad. 1, 4 (1961) A9-A11.

Some of the fundamental problems and applied problems in the use of irradiation for the control of insects in grain are examined, and a comparison is made with conventional methods. A detailed appraisal was published earlier in J. Sci. Food Agric. 11: 1960, 754 (Cornwell and Bull, Insect control by gamma-irradiation - an appraisal of the potentialities and problems involved). Three major factors which discourage commercial exploitation at present are (1) sources of 1-2 Mc Co^{60} are required to accomodate the product at 200 tons/h, the minimum handling rate demanded by the trade, (2) capital expenditure for these massive sources is prohibitive, and (3) operating costs are not competitive with conventional measures of insect control. With the significant advances made during the last 2 years in the development of electron machines, with considerably greater power outputs than the present accelerators, but with low beam energy, some of these factors should be resolved in the future,

See also:

1487 Study Report. Cobalt-60 bulk grain irradiator. (Brookhaven National Lab., Upton, N.Y. and Vitro Engineering Co., New York, 1963).
1490 The potential value of gamma radiation in the wheat industry. (Brownell, 1963).
1492 Development of irradiation facilities. (Dietz, 1963).

II-C-4 DETECTION

1503 British Standards Institution, London. METHOD OF TEST FOR TOXICITY OF WOOD PRESERVATIVES TO THE WOOD-BORING INSECTS Anobium punctatum AND Hylotrupes bajulus BY LARVAL TRANSFER. British Standard No. 3651. 1963. 15p.

Details of a larval transfer method for use with A. punctatum and H. bajulus are given. It is applicable to tar-oil, water-borne and organic-solvent types of preservatives, though comparisons between these groups

are not necessarily reliable, and directions are given for selecting and preparing the wood blocks, impregnating them with the preservative, boring the holes into which the larvae are to be inserted, conditioning the blocks before use, maintaining the larvae before use and inserting them into the blocks, the maintenance of the infested blocks, their subsequent examination with or without x-rays, and the evaluation and reporting of the results. Appendices contain information on precautions against infestation by Pyemotes ventricosus (Newp.), which sometimes affects tests with A. punctatum, the method of obtaining young larvae of H. bajulus and the use of x-rays to detect living larvae within the blocks. (From RAE-A 52: 1964, 8)

1504 Berryman, A.A. RADIOGRAPHIC TECHNIQUES FOR THE DETECTION, SAMPLING AND BIOLOGICAL STUDIES OF FOREST INSECTS. Thesis. California Univ., Berkeley. 1961. 40p.

An x-ray study of cryptic insects (including Ips confusus (Le Conte)).

1505 Berryman, A.A., Stark, R.W. RADIOGRAPHY IN FOREST ENTOMOLOGY. Ann. ent. Soc. Amer. 55, 4 (1962) 456-66.

The use of radiography in the study of cryptic insects was investigated for several kinds of forest insect damage. Longwave or "soft" x-rays (5-35 KV) were found most suitable for the detection and study of insects infesting plant material. A portable industrial x-ray unit was used which had an output of up to 35 kV, 10 mA and variable exposure time. Excellent results were achieved in radiographs of western pine beetle larvae and pupae in ponderosa pine bark; adult gallery construction and larval development of Ips confusus (LeConte); red turpentine beetle in situ in sugar pine; buprestics, cerambycids, siricids, and lyctids infesting various thicknesses and kinds of timber; weevils infesting lodgepole pine tips and seed-infesting insects. Less satisfactory was the detection of insects in whole cones, although their galleries could be detected. (Auth.)

1506 Berryman, A.A., Stark, R.W., STUDIES ON THE EFFECTS OF TEMPERATRUE ON THE DEVELOPMENT OF Ips confusus USING RADIOGRAPHIC TECHNIQUES. Ecology 43, 4 (1962) 722-6.

Limitations and possible improvements of the method are discussed. "Soft", low kV x-rays proved most satisfactory, providing penetration was adequate and the time exposure was short enough to minimize radiograph blurring from insect movement. The rate of adult gallery construction and brood development at 5 constant temperatures (15°, 20°, 25°, 30°, and 35° C) was observed. Maximum rate of brood development occurred at 30° to 25° C and a sharp reduction in activity occurred at 15° C. Greatest numbers of progeny were produced at 20° C and highest brood survival occurred at this temperature and at 25° C. The data on brood mortality were suggestive of high mortality in the egg and larval stages at all temperatures and a high mortality in pupal and adult stages at the lowest and 2 highest temperatures. Adults emerging from slabs at the 35° C level were significantly smaller than those reared at lower temperatures.

1507 Bletchly, J.D., Baldwin, W.F. USE OF X-RAYS IN STUDIES OF WOOD BORING INSECTS. Wood 27 (1962) 485-8.

After reviewing work in the field to date, and the effects of radiation on wood-boring insects, modern techniques are discussed. Recent advances in equipment design have made it possible to use x-rays for obtaining clear photographs of insect larvae [the death-watch beetle (Xestobium rufovillosum), the house longhorn beetle (Hylotrupes bajulus), and the common furniture beetle (Anobium punctatum)] within wood and to follow their development without destructive examination of their environment. This facilitates evaluation of wood preservatives as well as biological research. Short exposures at low-voltage x-rays are likely to have little effect on the viability of insects within wood. Nevertheless, there are certain difficulties, e.g. detecting certain larvae depends on their age and mineral content. The presence and distribution of parasites of wood-boring insects may also be revealed by x-rays as for the parasites Pyemotes (Pediculoides) ventricosus and Theocolax formiciformis. It is altogether doubtful if x-ray examination of structural timbers in situ could be relied on to determine whether or not attack was still active. In large timbers, the ratio of timber thickness to larval size would be too great to provide the necessary contrast, and other factors would complicate interpretation. Only in wood of small sectional thickness can these difficulties be overcome. It is unlikely that x-rays could be used economically in routine examinations for quarantine purposes.

1508 Brett, G.A., Hurlock, E.T., Gradidge, G.M.G. EFFECT OF MALATHION ON LARVAE OF THE GRAIN WEEVIL (Sitophilus granarius (L.)). p.11 in "Infestation Control. A Report on the Work of the Infestation Control Laboratory 1959-1961". Gt. Brit. Ministry of Agriculture, Fisheries and Food. London, H.M.S.O. 1962.

S. granarius were allowed to oviposit for 4 d on samples of sterilized wheat and then sieved off; 2 batches of the infested wheat were then treated with malathion dust at 12 ppm. All samples, incubated at 25°C and 70% R.H., were examined at intervals by the Howe-Oxley CO_2 production test and by x-ray photography. Adults were removed from controls as they emerged, but not from the treated samples in which they died quickly. High CO_2 figures were found throughout, but those in the treated samples (2.88%), were only 63% of those in the controls (4.55%). The presence of large numbers of immature stages was confirmed by x-ray. Sufficient larval development to cause heating therefore could take place in grain already attacked by S. granarius and subsequently treated by malathion. Malathion not only killed the adults on emergence but also reduced the population of immature stages.

1509 DeMars, C.J., Jr. A COMPARISION OF RADIOGRAPH ANALYSIS AND BARK DISSECTION IN ESTIMATING NUMBERS OF WESTERN PINE BEETLE. Canad. Ent. 95, 10 (1963) 1112-6.

Estimates of the numbers of the western pine beetle, Dendroctonus brevicornis LeConte, in Pinus ponderosa Laws. bark samples were made by radiographs of 25 bark samples and by dissection counts of the bark. High correlations ($r = > .9$) between the 2 methods were found for (a) live larvae, (b) live plus dead larvae, (c) live of all stages combined, and (d) live plus dead of all stages combined. The bark dissection method took 8 times as long and was $4\frac{1}{3}$ times as expensive as the radiographic interpretation method of estimating bark beetle numbers. A Picker x-ray unit was used, and the samples classified by thickness ($> \frac{3}{4}$ inch or $< \frac{3}{4}$ inch). (Essentially auth.).

1510 Dennis, N.M., Decker, R.W. A METHOD AND MACHINE FOR DETECTING LIVING INTERNAL INSECT INFESTATION IN WHEAT. J. econ. Ent. 55, 2 (1962) 199-203.

Of the many methods developed for detecting hidden insect infestation in grain, only the x-ray -radiographic and the cracking-flotation techniques have found any degree of acceptance. Technical difficulties involved, however, have led to the search for a simpler method. A promising chemical indicator technique uses the body fluids of the insects to produce a colour reaction with ninhydrin-impregnated filter paper. The accuracy of the x-ray technique was found to be inferior for low-level infestation. A table is given comparing the relative performance of the x-ray and ninhydrin techniques for wheat infestation. The unit described is a proto-type. An improved unit has been built which will be field-tested against the x-ray method.

1511* Eidmann, H. OM LÄRKSKOTTMALEN (Argyresthia laevigatella H.S.) I SVERIGE. (Study on the larch moth, Argyresthia laevigatella H.S., in Sweden). Medd. Skogsforsøksv. Inst. 49, 3 (1960) 22S. (In Swedish)

The development of insect larvae was studied by x-ray photography. The entire post-embryonic development of A. laevigatella takes place lengthwise inside the new shoots. It is quite impossible to detect infestation in the autumn by external inspection. By means of x-rays it is possible not only to detect infestation but also to observe the development and behaviour of the larvae. Pupation and eclosure can also be followed.

1512 Eidmann, H. UNTERSUCHUNGEN ÜBER DIE ENTWICKLUNG VON PARASITEN BEI Coleophora laricella Hbn. MIT HILFE VON RÖNTGENPHOTOGRAPHIE. (Study on the development of parasites in Coleophora laricella Hbn. by means of x-ray photography). Z. angew. Ent. 50, 1 (1962) 118-25. (In German, with English summary)

In late autumn the larvae of the parasites Epilampsis boops Thoms. and Cirrospilus pictus Nees (Eulophidae) attain full growth and kill their hosts, the larvae of Coleophora laricella Hbn. They do not normally pupate until the following spring, but in the laboratory adults can be reared during winter. The developmental patterns of the parasites were constructed from observations during rearing experiments combined with repeated x-ray photography. Differences in development among the two species and sexes were found. No difference between x-ray treated and untreated animals was detected. For x-raying, model TEA-25 (Schönander) was used. The tube is provided with a Be-window and produces very soft radiation. The object was placed at 25 cm distance, and optimum conditions for irradiation were a periof of $1\frac{1}{2}$ sec at 14 kV and 10 mA. A Gevaert OSRAY film was used. The results can have practical application in connection with control measures.

1513* Gustafsson, Å, Simak, M. X-RAY DIAGNOSTICS AND SEED QUALITY IN FORESTRY. p.398-413 in "Proceedings of the 12th Congress of the International Union of Forest Research Organizations, Oxford, 1956". Stockholm, Statens skogsforskningsinstitut. 1958. (Mimeographed).

Data are summarized on x-ray diagnostics in relation to certain problems in forestry. Amongst other methods used, x-rays have been employed for studying insect attacks and mechanical damage to seeds, and in diagnostics of old and dead seed. Seed of Picea abies is often severely damaged by various insect species. The damaged seed is considered in two groups: A- seeds with larvae, and B - seeds without larvae. Each group (in Sweden) is represented by distinct species, such as Plemeliella abietina Seitner and Megastigmus abietis Seitner for A, and Ernobius abietis F., Laspeyresia strobilella, and Dioryctria abietella for B. (A list of tree and shrub species so far examined by x-ray photography is included. The bulk of the paper is concerned with seed development and selection).

1514 Hurlock, E.T., Armstrong, M.T. MINOR ENTOMOLOGICAL INVESTIGATIONS. p.16 in "Infestation Control. A Report on the Work of the Infestation Control Laboratory 1959-1961". Gt. Brit. Ministry of Agriculture, Fisheries and Food, London, H.M.S.O. 1962.

Tests were carried out to detect and measure hidden infestation by Araecerus fasciculatus and Lasioderma serricorne in cocoa beans using the Howe-Oxley CO_2 production test and x-ray photography respectively. The latter proved to be much more reliable as the CO_2 test gave anomalous results, probably due to the presence of moulds.

1515 Hurlock, E.T. DETECTION OF INSECTS IN DRIED PEAS; X-RAYS SHOW MOST PROMISE AMONG 8 METHODS. Food Manuf. 38, 7 (1963) 367-9

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1516 Jacquiot, C. L'UTILISATION DES RAYONS X DANS LES RECHERCHES ET LES ESSAIS SUR LES INSECTES XYLOPHAGES. Corros. et Anti-corros. 9 (1961) 74-9.

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1517 Johnson, N.E., Molatore, H.D. X-RAY DETECTION OF DOUGLAS-FIR BEETLES REARED IN SLABS. Canad. Ent. 93 (1961) 928-31.

An improved method of rearing the Douglas-fir beetle, Dendroctonus pseudotsugae Hopk., was recently developed by using wax-coated slabs of Douglas-fir. By means of a Diagnostic Keleket x-ray machine at a local hospital it was possible to detect the presence of various stages of the Douglas-fir beetle beneath the bark of infested test slabs. The detection of insects by x-raying the slabs achieved an accuracy of 98% for parent adults and their egg galleries; 92% for callow adults, pupae and mature larvae and 65% for immature larvae. It thus appears that x-ray negatives of the slabs can be interpreted reliably for all stages except immature larvae. This non-destructive technique should have considerable utility in studies of the development of bark beetles.

1518 Johnson, N.E. CONE-SCALE NECROSIS AND SEED DAMAGE ASSOCIATED WITH ATTACKS BY DOUGLAS-FIR CONE MIDGES. For.Sci. 9, 1 (1963) 44-51.

Premature cone-scale necrosis was shown to follow, if not to result directly from attack of the Douglas-fir cone midge, Contarinia oregonensis. Contarinia washingtonensis was also shown to cause damage to Pseudotsuga menziesii seed, though normally of less consequence than that resulting from attack by C. oregonensis. Seeds from cones infested with C. washingtonensis were categorized into (1) seeds on a scale containing from 1-3 larvae, (2) seeds on a scale containing 4 or more larvae, and (3) seeds from uninfested scales of infested cones. In each category 300 seeds were examined by the use of x-rays and later tested for germination. Radiographs of seed from heavily-, moderately- and non-infested cones are shown. X-ray analysis and germination tests showed that C. washingtonensis has a detrimental effect on the seed of Douglas-fir. The number of midges per cone could be seen to be directly correlated with the number of necrotic cone scales, the number of galled seed, and the number of filled seed.

1519* Kremser, K. RÖNTGEN-DIAGNOSTIK IN DER ENTOMOLOGIE. (X-ray diagnosis in entomology). Fortschr. Röntgenstr. 76 (1952) 393-6.

Discussion of the possibilities and limitations of the method.

1520* Křístek, J. POUŽITI ROENTGENU KE KONTROLE ZÁMOTKŮ PILATEK. (The use of x-rays for checking sawfly pupae). Lesnická práce 36 (1957) 270-? (In Czech)

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1521* Oliver, A.C. USE OF X-RAYS IN THE DETECTION OF Teredo IN WOOD. Timb. Devl. Ass. Ltd. Test Record B/TR/2. London, 1959.

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1522* Piltz, H. DIE ROENTGEN-METHODE UND ANDERE METHODEN ZUR FESTSTELLUNG VON INNEREM KÄFERBEFALL BEI GETREIDE UND HÜLSENFRÜCHTEN. (The x-ray and other methods for detecting beetle infestation in corn and leguminous plant products). Anz. Schädlingsk. 28. (1955). 118. (In German)

Various methods of detection used routinely are reviewed and the corresponding documentation cited. The development of the x-ray method is traced and an apparatus described which is equally suitable for checking grain and leguminous plant products (peas, beans, etc.). In the latter case, the test insect was Callosobruchus quadrimaculatus F. The advantages are speed of checking ($\frac{1}{4}$h), precise assessments of degree of infestation and the stage of development of the infesting pest, and the fact that the material to be examined is in no way damaged by the test. Drawbacks are difficulties in deciding whether the insect is still alive, and the need for more extensive sampling, since individual samples are very small and therefore not fully representative.

1523 Schmidt, H. RÖNTGENSTRAHLEN MACHEN HAUSBOCKLARVEN IM HOLZ SICHTBAR. (X-rays render visible Hylotrupes bajulus L. larvae in infested wood). Umschau 62 (1962) 82-3 (In German)

A method is described for obtaining very clear x-ray photos of infesting larvae in wood up to a thickness of 50 mm. At 100 mm, a weaker picture is obtained which is, nevertheless, still interpretable. The usefulness of the technique is discussed, for detection and for studying insect behaviour.

1524* Simak, M. BESTÄMNING AV INSEKTSKADOR PÅ GRANFRÖ MEDELST RÖNTGENFOTOGRAFERING. (Insect damage to seeds of Norway spruce determined by x-ray photography). Särtryck Norrlands Skogsvårdsförbunds Tidsskr. 3 (1955) 299-310. (In Swedish, with English summary)

The damaged seeds fall naturally into 2 groups: A (seeds containing larvae) and B (seeds without larvae). The gall-fly Plemeliella abietina Seitner and Megastigmus abietis (group A) attack seed. Larvae of Plemeliella remain inside it for 2-3 years, also causing a reduction in seed size. Megastigmus does not alter the shape or colour of the seed. It has a life cycle of 1-2 years and becomes a chrysalis in the seed. Insects of group B can only be perceived by damage caused (e.g. puncture of the seed-coat, presence of frass), and are usually found further north than those of group A. The degree of infestation appears to diminish with increasing altitude. Insects influence the size of the cone and the all round quality of the seeds. X-ray photography is in every respect superior to other methods of macroscopic examination. Secondary insect damage, especially reductions in seed quality, can be determined exactly, and the method also gives wider scope for studies on evolution, occurrence, habits and ecology, etc. of the infesting insects.

1525 Stark, R.W., Adams, R.S. X-RAY INSPECTION TECHNIQUE AIDS FOREST TREE SEED EVALUATION. Calif. Agric. 17, 7 (1963) 6-7.

A prime factor in seed production for reforestation is insect damage, which often is not visible externally. Proportions of empty and sound seeds and of deformed or diseased embryos can be rapidly estimated by x-ray examination. (Auth).

1526 Stemley, P.G. THE LIFE HISTORY AND BEHAVIOR OF AN INTERNAL FEEDING STORED GRAIN INSECT, Rhizopertha Dominica (FAB.) BY USE OF X-RAY. Diss. Abstr. 23, 3 (1962) 1131.

The study was undertaken to determine life history, and habits of the insect inside wheat kernels. The rearing medium was Pawnee variety of hard red winter wheat, cleaned and adjusted to (12 ± 0.5)% moisture; rearing was done at (80±2)°F and at (70±2)% R.H. A General Electric X-ray Grain Inspection Unit was used to record the growth, development, and activities inside the kernels. Kernels were also cut open to observe the developmental stages. Larvae bored into kernels within 5-8 h. When more than one larva entered the same kernel combat occurred and only one survived if they came into contact with each other. Mortality of 1st-instars increasingly reduced from 6.9 to 14.30% moisture. Radiographs showed the average duration of instars to be: 1st - 5.80 d; 2nd - 4.35 d; 3rd - 4.62 d; 4th - 4.00 d; prepupal stage - 1.55 d; pupal stage - 4.37 d. The larvae fed mostly lengthwise in kernels and pushed frass through the entrance hole with their heads.

1527 Варшалович, А.А. РЕНТГЕНОГРАФИЯ СЕМЯН ДЛЯ ОБНАРУЖЕНИЯ ЗАРАЖЕННОСТИ ИХ ВРЕДИТЕЛЯМИ. Защ. Раст. 4 (1958) 42-3.

Varshalovich, A.A. X-RAY EXAMINATION OF SEEDS FOR DETECTING INTERNAL INFESTATION BY PESTS. Zashch. Rast. 4 (1958) 42-3.

A special apparatus for x-raying seeds and a method for their entomological examination are described. The roentgenogram permits the stage of development of the pest to be established, as well as the extent of infestation, the efficacy of insecticides, and the presence of fungal and bacterial diseases. Roentgenograms are most important for the quarantine examination of imported cotton seeds, grains, and leguminous seeds. (See Referat. Zhur., Biol., 1959, 62854).

1528 Yuasa, H. ON THE ADVANTAGE OF THE X-RAY EXAMINATION OF CERTAIN CLASSES OF MATERIALS * INSECTS SUBJECT TO PLANT QUARANTINE REGULATIONS. Proc. 3rd Pan-Pacif-sci. Congr. Tokyo, 1 (1962) 1141.

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* Compiler: for?

See also:

1556 Use of x-ray stereoscopy for examining shipworm infestation in vivo. (Crisp et al., 1953).
1558 The use of x-ray photography in entomological studies. (Eidmann, 1959).

II - D Sericulture

1529 * Arifov, U.A., Klein, G.A., Okun', G.S., Pashinskiĭ, S.Z., Osipova, L.Kh., Faerman, V.T. INVESTIGATION IN VACUO OF THE DEFORMATION OF NATURAL SILK IRRADIATED BY γ- RAYS. Izv. Akad. Nauk UZb. SSR, Ser. fiz. mat. Nauk 3 (1960) 32-7. (In Russian)

Changes in dynamometric properties of γ-irradiated silk and raw silk fibers (produced from irradiated cocoons) in the presence of air and in vacuo (10^{-5} mm) were investigated. A Co^{60} γ-ray source and $3 \times 10^5 - 2 \times 10^6$ r equivalent physical irradiation doses have been used. Dynamometric tests in vacuo give less statistically disperse results, because of the stabilizing influence of the vacuum. Compared to the tests in the presence of air, with the same loads and deformation times, tests in vacuo show a sharp decrease of the absolute elongation of the fibers. The change in elongation is in vacuo proportional to the load (to 80 g), i.e., the plastic deformation for silk in vacuo is small and the elastic deformatiom predominates, while in presence of air the plastic deformation predominates. Irradiation of natural silk in vacuo (10^{-5} mm) with doses up to 10^6 r equivalent physical increases the strength of the fiber, i.e., a process of stitching of molecular chains predominates. Raw silk, in presence of air-irradiated cocoons (doses $3 \times 10^5 - 2 \times 10^6$ r equivalent physical, did not show a decrease of strength. (CA 55:1961, 2114c).

1530 Hirobe, T., Ooi, H. A SILKWORM BREEDING METHOD, TAKING ADVANTAGE OF THE DIFFERENCE OF RADIOSENSITIVITY. II. THE COMPARISON OF HEALTHINESS (INVOLVING VIABILITY, LONGEVITY, FECUNDITY, ETC.) BY IRRADIATION BETWEEN F$_1$ - HYBRIDS. 22nd Meeting of the Japanese Society of Breeding, 1962. Jap. J. Breed. 13, 1 (1963) 55. (In Japanese)

(BA 44: 1963, 16935).

1531 Ibragimov, A.P., Brodskaya, G.A. ACTION OF GAMMA RADIATION ON THE AMINO ACID COMPOSITION OF SILK FIBROIN. p.5-10 in "Nekotorȳe Voprosȳ Prikladnoĭ Fiziki", Sbornik, Tashkent, Akad. Nauk Uzb.SSR. 1961.(In Russian)

Fibroin from hybrid cocoons of mulberry silkworms was irradiated with γ-rays (Co^{60}) in doses of from 1 million to 50 million r. The acid hydrolyzates of irradiated and unirradiated fibroin were studied for changes in amino acid compound (chromatographic method) and for N content. A spectroscopic study was also made. In the beginning of radiation the content of total and amino N decreased rapidly. At doses over 25 million r the rate of decrease dropped sharply. In the hydrolyzate of unirradiated fibroin the content of alanine, phenylalanine, tyrosine, glycine + serine, glutamic acid + threonine, valine, histidine + lysine, and arginine decreased with increase in the dose of radiation. The percentage of the relative decrease in the content of these amino acids increases in the sequence of their enumeration. At the same time, new unidentified amino acids were detected. Hydrolyzates of irradiated and non-irradiated fibroin have identical absorption max. at 271 mμ. From Ref. Zh., Khim. 1962, Abstr. No. 2P532 (CA 57:1962, 10154b).

1532 Imai, Y. THE EFFECT OF γ-RAY IRRADIATION ON PROTEIN. II. THE ESR (ELECTRON-SPIN RESONANCE) ABSORPTION OF PROTEINS, AMINO ACIDS, AND PEPTIDES. J. Biochem., Tokyo 50 (1961) 284-92.

Anaerobic γ-ray irradiation (10^5 - 10^7 r) of albumin, fibrin, fibroin, and silk fibre produced asymmetric ESR signals closely related to those of cysteine and reduced glutathione. When irradiated silk fibre was examined for ESR by applying perpendicular magnetic field, a doublet signal resembling that of glycylglycylglycine was observed, presumably owing to interpeptide chain H bonding with free radicals. Aerobic irradiation of the proteins yielded a symmetric singlet (g = 2.003) signal, presumably of peroxide radicals. Those signals of irradiated proteins were undetectable if irradiation was performed in the presence of H_2O. The addition of irradiated protein or cysteine to native albumin solution decreased the amount of titrable SH groups. (CA 56: 1962, 10515 d).

See also:

870 Difference of radiation sensitivity between male and female upon the egg coulour-sex-limited, in the silkworm. (Hirobet and Yazaki, 1962).
1067 Studies on the breeding method taking advantage of γ-rays in the silkworm. (Japan. Sericultural Experiment Station, Tokyo, 1962).
1260 Studies on the breeding method taking advantage of γ-rays in the silkworm. (Japan. Sericultural Experiment Station, Tokyo, 1963).
1583 Present status and the future development of radiotechnology. (Stanković, 1962).

II - E Biological Control

1533* Evlakhova, A.A. EFFECT OF CERTAIN CHEMICAL AND PHYSICAL STIMULI ON THE GROWTH AND VIRULENCE OF ENTOMOPATHOGENIC FUNGI. BIOLOGICAL METHOD OF CONTROLLING PESTS. "Proceedings of the Joint Session on Plant Protection". Iz-stvo Akad. Nauk. SSSR. 1959. (In Russian).

1534 Евлахова, А.А. ИСПОЛЬЗОВАНИЕ ЭНТОМОПАТОГЕННЫХ ГРИБОВ В БОРЬБЕ С ВРЕДНЫМИ НАСЕКОМЫМИ. Бот. Ж. 46, 12 (1961) 1744-80. Р. Ж. Биол. №16Ж401. 1962.

Evlakhova, A.A. USE OF ENTOMO-PATHOGENIC FUNGI IN CONTROL OF HARMFUL INSECTS. Bot. Zh. 46, 12 (1961) 1774-80. R. Zh. Biol. No. 16Zh401. 1962.

Certain species of Entomophthora are host-specific and are capable of bringing about epizootics among many harmful insects. Their cultivation is difficult. Field tests in application of entomophthoraceus fungi were sometimes successful. Fungi imperfecti cause mycetic diseases. These fungi are cultivated on a large scale on steamed hay, grain residues, or on fallen leaves and other inexpensive base materials. A good yield of Beauveria bassiana was obtained on a mixture of corn and wheat extract with stimulants α-naphthyl acetic acid, 2,4-D, DDT, and microelements ($KMnO_4$ or $MnSO_4$ in concentrations of 0.02 to 0.1%). The article describes experiments in colonization of the fungi at pest foci and the amplification of effect of the biological preparation by small additives of insecticides. The virulence of fungi can be increased by controlled orientation on a culture with chitin and in the presence of chemical (DDT, BHC, petroleum products) and physical γ- and x-rays) effects. (BA 42:1963, 7891).

1535 Evlakhova, A.A., Martens, B.K. THE USE OF IONIZING RADIATIONS FOR INCREASING THE VIRULENCE OF ENTOMOGENOUS FUNGI. p. 20 - 21 in "Materials of the Symposium on the Use of Biophysics in the Field of Plant Protection". Leningrad, 1961. (In Russian)

Various processes were tested in experiments begun in 1957 for increasing the virulence of Beauveria bassiana and Aspergillus flavus, which give important control of insects. Virulent strains of the fungi were used and after treatment were tested in the laboratory on the noxious Pentatomid [Eurygaster integriceps Put.] and the apple Tortricid [Cydia pomonella (L.)] in comparison with the untreated fungi. Ultra-sounds and ultraviolet rays applied twice had little constant effect, but exposure of B. bassiana to soft x-rays and γ-radiation from Co^{60} gave positive results in the range 1200 - 40 000 r, and the former were effective even at 40 r. The effect depended not only on the species of fungus and the dose, but also on the stage of development of the fungus. The best results were obtained with young cultures in the mycelial and early sporulating stage. Insect mortality from the treated strains was increased by 30 – 40%. There was no increase in the virulence of A. flavus subjected to such treatment. In B. bassiana, the effect persisted for 7 - 10 generations. (RAE-A 51: 1963, 523).

II - F Insect Diseases

1536 Katznelson, H., Robb, J.A. THE USE OF γ- RADIATION FROM COBALT - 60 IN THE CONTROL OF DISEASES OF THE HONEYBEE AND THE STERILIZATION OF HONEY. Canad. J. Microbiol. 8 (1962) 175-9.

Honey-comb and honey heavily contaminated with spores of Bacillus larvae were sterilized after exposure to a dose of 1.5×10^6 to 2.0×10^6 rad from Co^{60}. Sugar-tolerant yeasts were killed by 10^6 rad and cysts of Nosema apis by 0.2×10^6 rad. (CA 57:1962, 2639i).

See also:

1321 A theory of the improved performance and survival produced by small doses of radiations and other poisons. (Sacher and Trucco, 1962).

TECHNIQUES

A Autoradiography

1537* Baeckeland, E., Chevremont, M. APPLICATIONS OF HISTOAUTORADIOGRAPHY IN ANIMAL CELLULAR BIOLOGY. Bull. Inst. agron. Gembloux Extra Vol. 2 (1960) 708 - 19. (In French).

The principle of the method is interpreted and applications in localization of radioactive isotopes are reviewed. The method is particularly valuable in determining the exact timing of deoxyribonucleic acid synthesis in mitosis. (CA 56: 1962, 2676 h).

1538 Branton, D. DRY, HIGH RESOLUTION AUTORADIOGRAPHY. Stain Tech. 37, 4 (1962) 239-42.

Microtomed sections of freeze-dried, paraffin-embedded tissues are placed on pieces of thin sheet-Teflon backed by a felt pad. The sections are then pressure-mounted on dry photographic emulsion. After suitable exposure, the sections are firmly cemented to the emulsion with 0.45% cellulose acetate in a 10 : 1 mixture of 2-butanone and acetone. This prevents the specimens from falling off or moving during photographic processing, though the tissue can be stained through the cellulose acetate binder. The method has been tested with tissues containing tritium-labelled DNA, and it produced resolution comparable to that obtained with standard liquid emulsion or stripping film techniques. (Auth.).

1539 Falk, G.J., King, R.C. RADIOAUTOGRAPHIC EFFICIENCY FOR TRITIUM AS A FUNCTION OF SECTION THICKNESS. Rad. Res. 20, 3 (1963) 466-79.

Data are presented relating radioautographic efficiency to section thickness which indicate that increased efficiency compensates in part for the decreasing radioactivity in increasingly thin sections. (In the tests, polymeric methacrylate was used as a substitute for tissue, together with Eastman Kodak NTB2 emulsion). The improved autoradiographic resolution obtainable in most cases by means of thinner (~ 0.5 μ) sections subsequently coated with thin films of suitably diluted liquid nuclear emulsion is pointed out.

1540 Herrmann, W., Hartmann, G., Brust, R. DAS AUFLÖSUNGSVERMÖGEN MIKROAUTORADIOGRAPHISCHER AUFNAHMEN UND UNTERSUCHUNGEN ÜBER SEINE ABHÄNGIGKEIT VON DER ENERGIE DER VERWENDETEN BETASTRAHLUNG [Teil I]. (The resolving power of microautoradiographic exposures and its dependence on the energy of β- radiation. I.). Atompraxis 7 (1961) 315 - 20. (In German)

The energy dependance of local resolving power is discussed for microautoradiographic exposures, using β- radiation. Close agreement is obtained between calculated values and those measured with the model described.

1541 Herrmann, W., Hartmann, G., Brust, R. DAS AUFLÖSUNGSVERMÖGEN MIKROAUTORADIOGRAPHISCHER AUFNAHMEN UND UNTERSUCHUNGEN ÜBER SEINE ABHÄNGIGKEIT VON DER ENERGIE DER VERWENDETEN BETASTRAHLUNG [Teil II]. (The resolving power of microautoradiographic exposures and its dependence on the energy of the β- radiation. II). Atompraxis 8 (1962) 8-11. (In German)

Experimental results are presented for radioisotopes Ni^{63}, S^{35}, I^{131}, Au^{198}, P^{32}, and K^{42}. The resolving power ranged from 5.3 μ for S^{35} to 93 μ for K^{42}. A graph shows three curves of resolving power plotted against energy, obtained from (1) calculated values, (2) the analogy model, and (3) experiment. It is thus possible to assess the suitability of an isotope, under the experimental conditions used, for a problem in which a particular resolving power is essential.

1542 Joftes, D.L. RADIOAUTOGRAPHY IN THE STUDY OF RADIOISOTOPICALLY-TAGGED SUBSTANCES IN INSECT CONTROL. p.155-66 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Review article illustrating the applicability of autoradiographic techniques to many different types of problems, since it can provide information on actual sites of deposition in tissues and even parts of cells. The technique places no restriction on the isotope used for labelling, since even the radiation from H^3 and C^{14} will register on the nuclear emulsion. In fact, H^3 and C^{14}(desirable since nearly every insecticide contains C and H) have the advantage of yielding high-resolution radioautograms, and even long exposures present no difficulty. Staining can be done before or after application of the emulsion, depending on the stain. The recommended techniques and the simple, generally available laboratory equipment required are described.

1543 Kempner, E.S., Miller, J.H. AUTORADIOGRAPHIC RESOLUTION OF DOUBLY LABELLED COMPOUNDS. *Science* *135* (1962) 1063-4.

When the electrons emitted by the istopes in a doubly labelled compound or a mixture of labelled compound have sufficient energy differences, resolution can be achieved by autoradiography with 2 sheets of x-ray film. Thus, C^{14} or S^{35} will affect only the closer film while P^{32} will affect both films. (CA 56;1962, 15104c).

1544 Lima-de-Faria, A. PROGRESS IN TRITIUM AUTORADIOGRAPHY. p.281-317 in "Progress in Biophysics and Biophysical Chemistry. Vol. XII". Butler, J.A.V., Huxley, H.E. Zirkle, R.E., Eds. Oxford, Pergamon Press. 1962.

This technique has permitted much information on DNA synthesis in chromosomes to be collected. It also lends itself to the study of the dynamics of chemical processes occurring within single chromatids and single chromosone loci. Tritium autoradiography has furnished clear-cut evidence of the occurrence of metabolic DNA in the giant chromosones of Diptera where disproportionate synthesis of DNA has been found at certain loci, and in the *Tipula* nuclei, where a Feulgen positive body incorporates large amounts of tritiated thymidine. This body is formed by the sex chromosones before meiosis and disintegrates at diplotene. Work on the following insects has been cited: *Tipula lateralis, Melanoplus differentialis, Drosophila melanogaster, Rhynchosciara,* and *Glyptotendipes.* (See p. 300-3, 306-7, 310-11, 313, and Figs. 9-13, 14 and 15).

1545 McGrath, R.A., Leach, W.M., Carlson, J.G. A SQUASH TECHNIQUE FOR AUTORADIOGRAPHY OF GRASSHOPPER NEUROBLASTS. *J. roy. microscop. Soc.* *82,* 1 (1963) 55-6.

A squash method, an autoradiographic procedure, and a staining technique designed primarily for study of grasshopper neuroblast chromosomes are described. Tissue is treated with 1% sodium citrate for 4-6 min to swell cells and separate chromosomes, fixed in 50% acetic acid for 5-30 min, and then squashed between a slide coated with potassium-chrome alum subbing and a No. 1 cover-glass. After further treatment slides are dipped into melted (39-40°C) Kodak NTB or NTB-2 emulsion, dried vertically and stored with silica gel at 4° C in light-tight boxes for the necessary exposure time. Processing is carried out at 17-18° C, with developer and fixer pre-filtered 1 h before use: full strength Kadak D-19 developer (4 min); distilled water rinse (15 sec), full strength Kodak acid fixer (5 min); running tap water (20 min). Slides are then rinsed (distilled water) and dried at room temperature. Squash preparations or autoradiograms are stained for 5-30 sec with 0.1% toluidine blue in citrate buffer at pH 5.0, rinsed in tertiary butyl alcohol (½- 2 min) and air-dried. They are then mounted as described.

See also:

139 Autoradiography as a method of detecting tagged rodents and their ectoparasites in a study of migration problems. (Shura-Bura and Kharlamov, 1961).
153 Autoradiography as a technique for radioactive phosphorus, P-32, uptake in *Cules molestus* Forsk. (Abdel-Malek and Abdel-Wahab, 1961).
177 Incorporation of iron-59 into the cells of different tissues of *Chironomus plumosus.* (Öktay and Sengün, 1963).
385 A micromethod for labeling steroids and ecdysone with tritium. (Karlson *et al.*, 1963).
679 Tissue distribution of P^{32}-labelled parathion. Autoradiographic technique. (Fredriksson and Bigelow, 1961).

B Dosimetry

1546 Kloft, W. TECHNICAL PROBLEMS OF RADIOISOTOPE MEASUREMENT IN INSECT METABOLISM. p.163-70 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

When measurements are made of emission from intact insects of radioisotopes present as tracers, various factors must be taken into account. Technical and mathematical ways of determining the value of absorption and back-scattering for different insect tissues are described. Thus the substitution of Al-filters for the excised tissue layers represents an indirect method of measuring absorption by the insect body. Mention is made of the problem of cuticular excretion of P^{32}, with subsequent changes in counting rates. All such complications are greatly reduced if γ-sources are used as tracers, and the measurements made with scintillation counters. If the γ- and β- radiations from the same insect are measured in close succession in the various experiments described, the size of the effects may be easily determined for the particular istope used. (In this study experiments were carried out on *Formica nigricans* Em., *Tenebrio molitor* L., and *Calliphora erythrocephala* Meig.)

See also:

409 Detoxication mechanisms in the tick *Boophilus decoloratus.* (Hitchcock and Smith, 1963).
532 Determination of the γ- isomer of hexachlorocyclohexane by istope dilution. (Atalla and Lima, 1963).
539 Determination of δ- hexachlorocyclohexane by the method of isotope dilution. (Kulikova *et al.* 1963).
704 Pesticides residues. Use of radioactive tracer method to determine possible residues in milk and meat from dairy cows. (Cutkomp, 1960).

C Isotope Dilution

1547 Sieber, K., Jumar, A. AN ISOTOPE DILUTION TECHNIQUE WAS USED TO DETERMINE THE γ- HCH CONTENT IN COMMERCIAL MIXTURES. Symposium über Schädlingsbekämpfung, Magdeburg, 1962. DDR.

D Labelled Pool Technique

See:

412 Radioactive tracer techniques in insect biochemistry. (Winteringham, 1962).
421 Nucleotides and other phosphorus compounds of cockroach nerve. (Heslop and Ray, 1961).
517 Drywood termite metabolism of Vikane fumigant as shown by labeled pool technique. (Meikle *et al.*, 1963)

The method is used in a variety of studies. See also subject index under Amino acids, and Sterol metabolism.

E Neutron Activation Analysis

1548 Castro, C.E., Schmitt, R.A. DIRECT ELEMENTAL ANALYSIS OF CITRUS CROPS BY INSTRUMENTAL NEUTRON ACTIVATION. A RAPID METHOD FOR TOTAL BROMIDE, CHLORIDE, MANGANESE, SODIUM AND POTASSIUM RESIDUES. *J. agric. Food Chem.* *10,* 3 (1962) 236-9.

An entirely instrumental method of neutron activation analysis has been successfully employed to analyze directly the total bromine residues in raw navel orange peel and juice. The inorganic bromine found was the result of fumigation with the nematocide, 1, 2-dibromo-3-chloropropane. Simultaneously, the amounts of Na, K. Mn and Cl were quantitatively determined from the same set of γ- ray spectra. No organic bromides were detected in these fruit, all of which had been harvested from trees 8 months after nematocide application. As a method of residue analysis for Br, the procedure outlined is non-destructive, the sample preparation required is niminal, and the method is extremely rapid. The sensitivity and wide scope of the technique are striking. The authors intend to explore the biochemistry of plant-parasitic nematodes and their host relationships utilizing this technique.

1549 Gunther, F. A. INSTRUMENTATION IN PESTICIDE RESIDUE DETERMINATIONS. p. 191-319 in "Advance in Pest Control Research. Vol V." Metcalf, R. L. Ed., Interscience Publishers, New York. 1962.

Comprehensive review article. A section (p. 263-72) is devoted to neutron activation analysis (theory; typical neutron-activation procedure; instrumental neutron-activation analysis; and instruments required).

1550 Schmitt, R. A. NEUTRON ACTIVATION ANALYSIS. p. 281-324 in "Analytical Methods for Pesticides, Plant Growth Regulators, and Food Additives. Vol. I, Principles, Methods, and General Application". Zweig, G., Ed. New York, Academic Press. 1963.

Very comprehensive review article, divided into sections on the theory of neutron activation, neutron activation procedure (sample preparation, irradiations, post-irradiation instrumental analyses, calculation of concentrations from γ-ray spectra), sensitivities for thermal-neutron activation, applications of neutron activation analysis (general, and specific applications to pesticide residues), and instrumentation and neutron sources. P. 303-20 treat application to pesticide residues, and unpublished results by various authors are cited (p. 318-9). An attempt was made to correlate the total organic chloride content with chlorinated pesticide levels in milk butterfat. In 90% of the butterfat samples, the total organic chloride content was ≥ 10 times the chloride content determined for the pesticides DDT, DDE, BHC, and TDE by chromatographic techniques. The tremendous potentialities of neutron activation analysis in pesticide residue work is stressed, given its simplicity, the high sensitivities for such elements as Cl, Br, and I, multichannel quantitation from a single neutron irradiation, and the nondestructiveness of the analysis.

See also:

208 Neutron activation analysis for phosphorus in a study of development in a beetle wing. (Beck and Manney, 1962).
710 Total organic chloride content in butterfat by a rapid method of neutron activation analysis. (Schmitt and Zweig, 1962).
732 Bromine residues in wheat and milled wheat fractions fumigated with methyl bromide. (Lindgren *et al.*, 1962).
1300 Cell differentiation and radiopathology in the wing of *Tribolium confusum*. (Beck, 1962).
1301 Effects of x-irradiation upon cell population and morphogenesis in the wing of *Tribolium confusum*. (Beck, 1962)
1302 Effect of x-irradiation on cell differentiation and morphogenesis in a developing beetle wing. (Beck, 1962)

F Miscellaneous

1551 Bond, E. J., Call, F. APPARATUS FOR TREATING INSECTS WITH RADIOACTIVE FUMIGANTS. *J. econ. Ent.* *54*, 4 (1961) 808-9.

HC^{14}N was generated from KC^{14}N, of specific activity 0.2 mc/mM, and stored in a reservoir. The technique and apparatus are described. From there a known amount of fumigant could be introduced into the fumigation chamber. The rate of uptake of HC^{14}N is studied by incorporating and end-window GM-counter and measuring the decrease in concentration of radioactive gas as it is absorbed by the insect.

1552 Harrison, R. A. TOPICAL APPLICATION OF INSECTICIDE SOLUTIONS TO MITES AND SMALL INSECTS. *N. Z. J. Sci.* *4*, 3 (1961) 534-9.

The construction and procedure for use of such an apparatus for topical application of insecticide solutions to mites and insects of a mass of approx. 20 µg are described. The apparatus consists of a self-filling micro-pipette mounted and arranged in the field of view of a stereoscopic microscope. The doses delivered to individual insects ranged from 0.0005 µl to 0.00005 µl according to the size of the micro-pipette used. Replicable results have been obtained using this method of treatment. Calibrations is effected microscopically and checked radiometrically, using repeated doses of kerosene solutions of P^{32}-labelled tributyl phosphate. The volume of liquid delivered was within 5% of the estimated volumes. A check on the variation of individual doses from the same capillary tube was also made radiometrically. The coefficient of variation for doses applied to paper was 5%, to mites 18% and to larvae 5%. The whole treatment of one insect takes a minute or less.

1553 Lewis, C. T. DIFFUSION OF OIL FILMS OVER INSECTS. *Nature*, Lond. *193*, 4818 (1962) 904.

Measurements of the rate of uptake of oil by active flies (*Phormia terraenovae* R-D) were made by using I^{131}-labelled oil films. (I^{131}-labelled di-iodo-octadecane was added to a refined mineral oil - Risella 17 - the specific activity being adjusted to 3 µl/cm^2.) Estimates of the rates of contamination of the insect with oil and of subsequent tissue absorption of tracer were made. Autoradiographs confirmed that oil films were established over the whole of the integument within a very few minutes after initial exposure. It was calculated that a monomolecular oil film was established within 5-15 min of the first contact of the fly with the oil deposit. The oil film advanced only when the integument was part of a living, active insect, and this is discussed. Similar results were obtained with *Dysdercus fasciatus*.

1554 Lewis, C. T. RADIOTRACER STUDIES OF OIL FILMS ON INSECTS. (Abstr.) p. 629 in "XI. Internationaler Kongress für Entomologie, Wien, 17. bis 25. August 1960. Verhandlungen. Band II (Symposien)". Wien, Organisationskomitee des XI. Internationalen Kongresses für Entomologie, Wien 1960. 1962. (In English)

Quantitative data concerning the uptake of oil by insects walking over fine deposits have been obtained by means of radioactive oil samples prepared by the addition of I^{131} to traces of an unsaturated hydrocarbon. For a range of species walking over a mineral oil (Risella 17) deposit of 3 µl/cm^2 on filter paper, the initial rate of flow on to the cuticle is found to be extremely small, varying from 2.3×10^{-8} ml to 3.0×10^{-7} ml/min. Nevertheless, an appreciable fraction of the oil thus transferred to the tarsi rapidly diffuses over the epicuticle, to cover the entire body surface with a fine film within a very few minutes, to which more oil accumulates at a steadily decreasing rate. The long-term approach to equilibrium between the oil on the substratum and the oil film on the insect has also been studied; a near-approach to such an equilibrium is achieved in "crawling insect" biological assay techniques. For example, the film of oil taken up by *Carpophilus dimidiatus* larvae rises to a maximum level in 5 h; in contrast, *Tribolium castaneum* adults take about 24 h to approach equilibrium. (This work froms part of an investigation to be reported in detail elsewhere).

1555 Lewis, C. T. SOME APPLICATIONS OF RADIOISOTPES TO THE STUDY OF THE CONTAMINATION OF INSECTS BY INSECTICIDE SOLUTIONS. p. 135-42 in "Radiation and Radioisotpes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April 1963". Vienna, International Atomic Energy Agency. 1963.

Preliminary work was carried out using di-iodo-octadecane-I^{131} as a tracer in solution in oils. This substance proved useful for investigating the creep of oil films over insect epicuticle, but was unsatisfactory for critical work on oil absorption through the cuticle, being converted in the tissues to one or more water-soluble derivatives. *Phormia terraenovae* R-D was used in this work. In subsequent investigations, dieldrin-C^{14} was used in solution in oils labelled with tritiated hexadecane. In comparative experiments with *Tribolium castaneaum* exposed to 3 solutions of different viscosity, appreciable differences in both the rates of diffusion over the insects and in absorption through the cuticle have been found. After an initial period, dieldrin is absorbed relatively faster than solvent, the magnitude of the differential absorption varying with viscosity. (Essentially auth.).

See also:

303 Radiometric assay of acetylcholinesterase. (Winteringham and Disney, 1962).
455 An apparatus for arthoropod labeling by means of spraying them with radioactive isotopes. (Khudakov, 1961).
500 A new bioassay technique, with special reference to the specific bioassay of DDVP insecticide. (Sun and Johnson, 1963).
990 The grasshopper neuroblast culture technique and its value in radiobiological studies.

1556* Crisp, D.J., Jones, L.W.G., Watson, W. USE OF X-RAY STEREOSCOPY FOR EXAMINING SHIPWORM INFESTATION IN VIVO. Nature, Lond. 172 (1953) 408-9.

The smallest portable x-ray set obtainable may be used, with Ilfex film. Infested blocks were scraped clean of surface growths and photographed in the laboratory, marked, and replaced in the sea. The whole course of attack could thus be followed in a series of experiments on infected blocks and information obtained on the times and preferred positions of settlement, on growth-rates, and growth habits. In order to interpret the arrangement of the burrows stereoscopy was introduced. Boring habits could be followed from the moment of entry of the individual shipworm, Teredo sp., into the wood.

1557 Davey, K.G., Treherne, J.E. STUDIES ON CROP FUNCTION IN THE COCKROACH (Periplaneta americana L.) I. THE MECHANISM OF CROP-EMPTYING. J. exp. Biol. 40 (1963) 763-73.

The structure and mode of action of the pro-ventriculus are described. X-ray photographs have shown that as the crop empties the decrease in volume of the fluid is partially compensated for by the swallowing of air. The effects of various factors upon the rate of crop-emptying have been studied using solutions of different osmotic pressures. Changes in viscosity, effected by the addition of methyl cellulose, produce only a minor reduction in crop-emptying. The frequency of opening of the proventricular valve is not proportional to the rate of crop-emptying over the whole range of concentrations used, and it is assumed that changes in other parameters must affect the process. (Auth. summary).

1558* Eidmann, H. DIE VERWENDUNG VON RÖNTGENPHOTOGRAPHIE BEI ENTOMOLOGISCHEN UNTERSUCHUNGEN. (The use of x-ray photography in entomological studies). Ent. Ts. Årg. 80, 3/4 (1959) 85-90 (In German)

Very soft rays from x-ray model TEA-25 (Schönander) were used, at 25 cm from the object, and through a Be-window. Ilfex film and exposure times from 3-7 sec (14 kV, 10 mA) were used. No damaging effect from radiatio was observed. Internal infestation of larch by Argyresthia laevigatella H.S. can be followed in its various stages of development, althought the shoots themselves show no outward sign of attack. Pupation and emergence can be diagnosed, also whether a cocoon contains a live or dead insect. X-ray photographs are also shown of cocoons of Pristiphora laricis Htg. and P. erichsoni Htg., being attacked by a parasitizing wasp larva, and of a sexually mature grasshopper, Carausius morosus Br. where, apart from the eggs other anatomical details are easily recognized. The possibilities of the technique are pointed out.

1559 Goodhue, D. SOME DIFFERENCES IN THE PASSAGE OF FOOD THROUGH THE INTESTINES OF THE DESERT AND MIGRATORY LOCUSTS. Nature, Lond. 200 (1963) 288-9.

An x-ray technique (see Radiography 1958, p.263) was used to study the passage of radiopaque foods through the intestine of the migratory locust, Locusta migratoriodes R. and F., and the desert locust, Schistocerca gregaria (Forsk), prior to an investigation into the absorption of stomach poisons. Differences in the form of the colon, particularly the S-bend, in fed and unfed insects and changes during defaecation are described. The S-bend is present in both fed and unfed Locusta but is reduced in a hungry Schistocerca, the colon remaining almost straight. Its significance is discussed. In Locusta intestinal contents pass into both arms of the caeca at the anterior end of the midgut, in Schistocerca intestinal contents are only found in the posterior arms, the anterior arms remaining unfilled. A peritrophic membrane is found in the posterior arm.

1560 Green, G.W. SPONTANEOUS LOCOMOTOR ACTIVITY IN THE BLOWFLY, Phormia regina Meig. Diss. Abstr. 24, 5 (1963) 2193.

When active, starved flies are fed to repletion on sugar solutions, locomotor activity is immediately and markedly depressed. Upon subsequent deprivation, locomotor activity increases at a rate that is dependent upon the concentration of the sugar ingested. An x-ray technique was developed to measure the rate of crop emptying in individual flies after feeding to repletion. Activity experiments performed in conjunction with the x-ray studies showed that after feeding to repletion, locomotor activity remains at a low level until approximately 90% of the crop contents have been utilized. Thereafter, locomotor activity begins to increase. The shape of the activity curve upon deprivation is dependent upon fewer periods of complete locomotor inactivity as the deprivation period is extended, rather than on an increase in the speed of movement. An explanation is put forward of spontaneous locomotor activity on the basis of a neurohumoral mechanism involving foregut receptors and neurosecretory cells in the protocerebrum and/or the corpus cardiacum.

1561 Odum, E.P., Loughman, B.C., Martin, R.P. SCANNING SYSTEMS FOR THE RAPID DETERMINATION OF RADIOACTIVITY IN ECOLOGICAL MATERIALS. Ecology 43, 1 (1962) 171-3.

In many applications of radioisotopes to ecological problems it is more important to assay large numbers of samples at frequent intervals than to obtain detailed measurements at any one time. It was found that certain scanning systems, originally designed for paper chromatographic work, can be adapted for such rapid large-scale scanning. Two systems are described. A system at Oxford was very successfully used in a study of population density of P^{32}-labelled ants. Long strips of ants from recapture samples were attached to the endless belt that passed slowly in front of a shielded detector. The pen recorder located below the detector automatically recorded which individuals were tagged. Although it was only necessary to identify which ants in the sample had been previously marked, the actual amount of P^{32} present in the individuals could easily be determined by calibrating the setup in either of 2 ways: (1) by inserting in the strips ant bodies containing a known amount of isotope, or (2) by ashing and counting selected individuals which had already been scanned to determine μc amounts producing a given pulse height on the recorder. The 2nd system described involves only a simple modification of equipment commercially available in the U.S.A.

BIBLIOGRAPHIES AND GENERAL SURVEYS

A Bibliographies

1562 Binggeli, M-H. RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY. BIBLIOGRAPHIC SERIES No. 9. International Atomic Energy Agency, Vienna. STI/PUB/21/9. 1963. 414p.

Fully annotated bibliography for the 11-year period 1950-1960 which precedes the present 1961-1963 bibliography and follows a basically similar layout. A special feature of the subject index is the citation, alongside each reference, of the relevant radioisotope or radiation employed in the study. An appendix of tabulated summarizing data with supporting references from recent review articles is included.

1563 France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay. ISOTOPES, RAYONNEMENTS, AGRICULTURE. BULLETIN BIBLIOGRAPHIQUE.

References and keywords (in French) are presented on applications of radiation and radioisotopes in agriculture. The bulletin is issued monthly, the first number appearing in June 1963.

1564 Herskowitz, I.H. "Bibliography on the Genetics of Drosophila. Part Four". New York, McGraw-Hill Book Company, Inc. 344p. 1963.

The 3305 references in this bibliography cover the literature for the 6-year period 1957-1962 (inclusive). It also includes a number of pre-1957 titles which had not been listed in the earlier parts of the series. The bibliography contains primarily genetics work although some work on morphology, natural history, physiology, and systematics are also included. Nearly all references are directly concerned with *Drosophila*. Titles are arranged alphabetically according to first author, each reference being designated by a lowercase letter (first author) and a number (numbering starting anew with every new letter of the alphabet). The title index is divided into a general (subject) index, a geographical, and a systematic index.

1565 Klement, A.W., Jr. TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A SELECTED BIBLIOGRAPHY. TID-3910, Division of Biology and Medicine, AEC. Mar. 1962. 79p.

A listing (alphabetically, by senior author) of 1980 references and 50 bibliographies. No abstracts, author index or subject index are given. Numerous references cited here were listed in "Radioisotpes and Ionizing Radiations in Entomology", Bibliographical Series No. 9, International Atomic Energy Agency, Vienna 1963, which covered the period 1950-1960 (inclusive).

1566 Klement, A.W., Jr., Schultz, V. TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A SELECTED BIBLIOGRAPHY. TID-3910 Suppl. 1, Division of Biology and Medicine, AEC. Feb. 1963. 95p.

A listing (alphabetically, by senior author) of over 900 references, including numerous references also covered by the present bibliography. No abstracts, author index or subject index.

1567 Pierce, C.M. THE EFFECTS OF RADIATION AND RADIOISOTOPES ON THE LIFE PROCESSES. AN ANNOTATED BIBLIOGRAPHY. TID-3098. 1963. 736p.

A total of 11 944 annotated references cover the years 1958, 1959 and 1960. An author and a permutated-title subject index are included. Abstracts are reproduced directly from the particular source used.

See also:

1422 Information circular on radiation techniques and their application to insect pests. (International Atomic Energy Agency, Vienna. 1963).

B Surveys. Instruction Manuals.

Comprehensive Project Surveys. Proceedings

1568 Андреев, С.В., Рутенберг, Е.П. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ И ИЗЛУЧЕНИЙ ДЛЯ РЕШЕНИЯ ВОПРОСОВ ЗАЩИТЫ РАСТЕНИЙ, СТЕРИЛИЗАЦИИ И ХРАНЕНИЯ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ПРОДУКТОВ. Стр. 3-13 в сб. "Сборник иностранной сельскохозяйственной информации". М. 1956.

Andreev, S.V., Rutenberg, E.P. Sb. inostrannoi sel'skokh. Inform., Moscow (1956) 3-13.

Use of radioisotopes and radiation in plant protection and the sterilization and conservation of agricultural produce.

1569 Андреев, С.В., Мартенс, Б.К., Молчанова, В.А. ПРИМЕНЕНИЕ РАДИОАКТИВНЫХ ИЗОТОПОВ ПРИ ИЗУЧЕНИИ ВОПРОСОВ ЗАЩИТЫ РАСТЕНИЙ. Стр. 23-35 в сб. "Радиоизотопы и радиация в энтомологии. Труды Симпозиума, Бомбей, 5-9 декабря, 1960". Вена, Международное агентство по атомной энергии. 1962.

Andreev, S.V., Martens, B.K., Molchanova, V.A. THE USE OF RADIOISOTOPES AND RADIATION IN THE FIELD OF PLANT PROTECTION. p. 23-35 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

A review article. Investigations being carried out in the Soviet Union in the field of plant protection are discussed. Ionizing radiation is used for its effects on microorganisms, crop seeds, and insects. By means of the effects of ionizing radiation on microorganisms, strains of entomopathological fungi (Beauveria bassiana and Aspergillus flavus) of increased virulence have been produced. Sterilizing doses for stored products pests have been worked out and used as the basis for the design of a gamma deinsector. The use of isotopes as tracers has made it possible to follow the dynamics of the movement of insecticides within plants and within the organisms of pests; to make a comparative evaluation of toxic agents having a systemic action; and to ascertain the duration of the toxic characteristics of such agents in plants and agricultural produce, which is very important for defining the safe time-limits for using toxic agents on agricultural crops. Further uses of radioisotopes in labelling toxic chemicals and agricultural pests are also discussed, and their usefulness in studying predator-parasite-host relationships, food cycles, migration and reservoir areas, population size, etc. (Also available in translation, as AEC-tr-5142).

1570 Андреев, С.В., Мартенс, Б.К., Молчанова, В.А., Самойлова, З.И. ИСПОЛЬЗОВАНИЕ РАДИОИЗОТОПОВ И РАДИАЦИИ В БОРЬБЕ С НАСЕКОМЫМИ-ВРЕДИТЕЛЯМИ РАСТЕНИЙ И ЖИВОТНЫХ. Стр. 115-27 в сб. "Применение радиации и радиоизотопов в борьбе с наекомыми—сельскохозяйственными вредителями. Труды Симпозиума, Афины, 22-26 апреля, 1963". Вена, Международное агентство по атомной энергии. 1963.

Andreev, S.V., Martens, B.K., Molchanova, V.A., Samoilova, Z.I. USE OF RADIOISOTOPES AND RADIATION IN THE CONTROL OF PLANT AND ANIMAL INSECT PESTS. p. 115-27 in "Radiation and Radioisotopes Applied to Insects of Agricultural Importance. Proceedings of a Symposium, Athens, 22-26 April, 1963". Vienna, International Atomic Energy Agency. 1963.

Radioactive labelling of insects has been extremely promising in bioecology; the labelling of grain pests (Eurygaster integriceps Put., Hadena sordida Skh.) and grain-pest parasites (Meniscus agnatus Crow, Pseudogonia cinerascens Rond.) has provided information about their areas of migration, habitats, sizes of population and the feeding habits. The same technique was used to determine the rate of propagation of the Colorado beetle (Leptinotarsa decemlineota Say), which is subject to quarantine controls; subsequently, an extermination programme was carried out on the basis of the data obtained. It also provides a valuable means of studying the extremely complex problems of parasitism and predaceousness, in particular intermediate feeding cycles and chemotaxis. The feeding areas of field rodents have been mapped out with the help of self-labelling, radioactive-bait techniques. The migration of Xenopsylla cheopis and Ceratophyllus fasciatus were studied. Hydrolysis rates of insecticides of the Thiophos and Metaphos type were determined as a function of plant development and physiological state, as well as of environmental conditions, and residue data obtained. The merits of various spraying techniques and doses were also studied. Experiments have shown that ionizing radiations can be used to increase the virulence of insect nosophytes (Beauveria vassiana Unill.) and thus improve the efficiency of microbiological insect-pest-control methods.

Sterilizing doses of γ-rays have been established for a number of insect pests which attack crops and stored products (Calandra granaria L., Acanthoscelides obtectus Say, Pectinophora malvella Hb., Leptinotarsa decemlineota Say, Chloridea obsoleta F.). Also published in JPRS-20425, 11p. (English Translation of a Russian paper).

1571 Atomic Energy Commission, Washington, D.C. FUNDAMENTAL NUCLEAR ENERGY RESEARCH 1962. A SPECIAL REPORT. 1962. 405p.

Includes effects on plant and insect life.

1572 Division of Technical Information, AEC. RESEARCH AND DEVELOPMENT IN PROGRESS. BIOLOGY AND MEDICINE. Issue No. 1. TID-4200. July 1963. 366p.

Approximately 600 AEC-sponsored projects supported by the Division of Biology and Medicine are covered. The publication is divided into two sections. The first section provides a scope note (abstract) and identifying information for each project. The second section consists of Principal Investigator, Contractor, Subject, and Contract Number Indexes.

1573 Division of Technical Information, AEC. RESEARCH AND DEVELOPMENT IN PROGRESS. BIOLOGY AND MEDICINE. ISSUE No. 2. TID-4201. November 1963. 323p.

1574 International Atomic Energy Agency, Vienna and Food and Agriculture Organization of the United Nations, Rome. "The Use of Radioisotopes and Radiation in Entomological Research". International Short Course, 7 October - 30 November 1963. Gainesville, Florida University, Department of Entomology. 1963. 92 p.

A series of lectures by internationally selected scientists covered the following topics: biological effects of ionizing radiation; effects of ionizing radiation on the ability of cells to synthesize DNA; techniques of tissue culture; application of tissue culture; the use of stable isotopes in biological studies; the use of labelled insecticides in the study of insect resistance and comparative metabolism in resistant and susceptible strains; disinfestation of stored foodstuffs by irradiation with particular reference to grain; plant systemic insecticides; factors in radiation of mass cuttings of the screwworm, especially under differing physical and atmospheric conditions; use of the sterile male technique for control of the screwworm; concepts and results with the sterile-male method of insect control; the sterile male technique on various species of tropical fruit flies; radiosensitivity of developing reproductive cells in insects, especially the screwworm; use of radiation for producing mutations in plants; some effects on γ-radiation and chemosterilants on Drosophila melanogaster; the use of radioisotopes in animal nutrition research; chemosterilants as a potential weapon for insect control; the effects of γ-radiation on the soil; immunization experiments with irradiated larvae; immunization experiments on oral lungworm vaccine; field trial of dictol on oral lungworm vaccine (D. viviparus) in cattle; the chemistry of insect chemosterilants; the use of radiation in food preservation; effect of x-ray exposure on the European corn borer; chemosterilants for the control of houseflies; and effects of γ-radiation on body lice. Laboratory instruction included demonstration of autoradiographs; chromosome preparations; distribution of radioactive food among social insects determination of the speed of haemolymph circulation in insects by insected tracers; the effect of temperature on the post-irradiation response of the rice weevil (Sitophilus zeamais); methods for conducting blood surveillance tests; methods of housefly spermathectomy; procedures to determine the effectiveness of residual applications of chemosterilants on glass; and biological half-life of radioisotopes in insects (grasshoppers).

1575 Kansu, A. RADYOIZOTOPLARIN ENTOMOLOJI ALANINDA KULLANILMASI. (Use of radioisotopes in entomology). Yüks. Zir. Enstit. Derg. (1963) 47-72. (In Turkish).

The publication appeared for a seminar. After an introduction the subject matter is broken down into bio-ecological and physiological studies, followed by a discussion of insect control by radiation. Various applications of radioisotopes are described.

1576 Knipling, E.F. THE USE AND LIMITATIONS OF ISOTOPES AND RADIATION STERILITY IN MEETING INSECT PROBLEMS. Int. J. appl. Rad. Isotopes 13 (1962) 417-26.

Uses and limitations of radioisotopes in advancing entomology research and for insect control are reviewed. The possible use of radiomimetic chemicals in lieu of irradiation as a means of inducing sterility in insects, the use of radioisotopes in insect population and dispersal studies, the use of isotopes in insect physiology and biochemical studies, the use of isotopes in studies on resistance to insecticides and hazards to man associated with the use of insecticides, and the use of isotopes for irradiating insects to produce sexual sterility or to destroy the insects are discussed. (NSA 17: 1963, 1559).

1577* Клечковский, В. ИСПОЛЬЗОВАНИЕ ИЗОТОПОВ И ИЗЛУЧЕНИЙ В СЕЛЬСКОМ ХОЗЯЙСТВЕ. Атомная энергия 4 (1957) 389-470.

Klechkovsky, V. USE OF ISOTOPES AND RADIATION IN AGRICULTURE. Atomnaya Energiya 4 (1957) 389-470.

1578* Kljajić, R. STANJE KORIŠCENJA RADIOIZOTOPA I JONIZUJUCIH ZRAČENJA U ZAŠTITI BILJA. (Present utilization of radioisotopes and ionizing radiations for plant protection). Zasht. Bilja 61 (1960) 89-101. (In Jugoslav, with English summary)

Review article with 75 references.

1579 Lindquist, A.W. NEW WAYS TO CONTROL INSECTS. Pest Control 29, 6 (1961) 9, 11, 12, 14, 16, 18, 19, 36, 38, 40.

Review article, emphasizing such promising control aspects as the sterile male technique, chemosterilants, combined insecticide and chemosterilant treatment, and others.

1580 Pesson, P. TRAVAUX DE RECHERCHES UTILISANT LES ISOTOPES ET LES RAYONNEMENTS NUCLÉAIRES EN ENTOMOLOGIE APPLIQUÉE EN FRANCE ET DANS LES PAYS ASSOCIÉS. p. 297-300 in "Radioisotopes and and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Dans une première partie, l'auteur passe en revue les travaux, effectués ou en cours en Haute-Volta, en Côte-d'Ivoire, à Bures-sur-Yvette (S. & O.) et à Bondy, qui utilisent des radioisotopes pour le marquage de simulies, de fourmis, d'Apis mellifica et d'Aphis leguminosae, ainsi que les projets de recherches dans les régions tropicales, en Afrique tropicale et en France pour le marquage de Perkinsiella, de trichogrammes, de Locusta migratoria et de certains moustiques ou de leurs prédateurs. Dans la seconde partie, il mentionne les études poursuivies sur la stérilisation des insectes (Apis mellifica, Ephestia kühniella, Calandra granaria, C. oryzae, Trogoderma, Acanthoscelides obtectus, Rhizopertha, Gnathocerus, Tenebrio et Sitotroga cerealella) et l'action cytologique des radiations ionisantes sur les gonades de Calandra granaria. (Auth.)

1581 Qayyum, H.A. THE SCOPE OF THE USE OF RADIOISOTOPES AND RADIATION SOURCES IN ENTOMOLOGY IN PAKISTAN. p. 281-4 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

The application of radioisotopes and radiation sources in entomological research in Pakistan is discussed. The problems which deserve to be investigated with the help of radioisotopes include a study of the migratory habits of insects such as Sylepta derogata F. (a threat to cotton), Apis dorsata F. and Apis indica F.

1582 Quraishi, M.S. SPOTLIGHT ON CINS* RESEARCH. II. ENTOMOLOGY. Bull. CENTO Inst. nucl. Sci. 2 (1963) 24-8.

Review of work in progress, which includes studies on plant and stored grain pests (Eurygaster integriceps, using Sc^{46}, P^{32} and Ta^{182}; Oxytheria cinctella; radiation effects and lethal doses on Bruchus sp.) and on malarial entomology (Anopheles stephensi, using P^{32}). Insecticides are mentioned but without details of intended studies. The names of the scientists involved in the various projects are given.

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* CENTO Institute of Nuclear Science [CENTO - Central Treaty Organization (Teheran)].

1583 Stanković, D. PRESENT STATUS AND THE FUTURE DEVELOPMENT OF RADIOTECHNOLOGY. Tehnika, Belgrade 17 (1962) 137-45.

Review article of the uses of ionizing radiations in Yugoslavia. A variety of problems and methods of investigation are described. Among the topics discussed are the control of stored products infestation and the killing of silkworm pupae.

1584 Strouhal, H.,Ed., Beier, M., Ed. XI. Internationaler Kongress für Entomologie, Wien, 17. bis 25. August 1960. Verhandlungen. Band III (Symposien). Wien, Organisationskomitee des XI. Internationalen Kongresses für Entomologie, Wien 1960. 1962. 348p.

The Proceedings of the Eleventh International Congress of Entomology [cf. RAE-B 52:1964, 105 etc.] conclude with the full text or abstracts of papers read at the 17 symposia that were held; those of the third and fourth of these were published separately.* The symposia of economic interest include [cf. also -A 52: 1964, 338] Symposium II, on the long-range displacement and migration of flying insects; Symposium V, on the host-seeking behaviour of mosquitoes; Symposium VI, on the transmission of disease by ticks and other Acarina; Symposium VII, on arthropods in relation to blood parasites, especially those of wild animals; Symposium XI, on insecticide resistance, and Symposium XVI, on applied acarology. Radioisotope studies contained in Symposia I, II and III are cited elsewhere in this bibliography. The remaining symposia were not available for scanning.

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* XI. Internationaler Kongress für Entomologie, Wien 1960. Verhandlungen. Band III. Symposium 3: Chemie der Insekten. Symposium 4: Chemische Verteidigungsmechanismen bei Arthropoden. Pavia, 1960. 293 p.

1585 Viado, G.B. THE FUTURE OF RADIOISOTOPES IN INSECT-CONTROL INVESTIGATIONS IN THE PHILIPPINES. p. 287-95 in "Radioisotopes and Radiation in Entomology. Proceedings of a Symposium, Bombay, 5-9 December 1960". Vienna, International Atomic Energy Agency. 1962.

Insect pests of the major and some of the minor crops and the extent of damage they cause in the Philippines are reviewed, in relation to the possible use of radioisotopes for their study and eventual control.

See also:

1 Study and formulation of methods of controlling plant pests and diseases by means of radioisotopes and radiation. (Andreev, 1957).
39 Quelques emplois des radioéléments et des rayonnements en entomologie. (Courtois and Lecomte, 1963).
90 Dispersal and migration. (Schneider, 1962).
412 Radioactive tracer techniques in insect biochemistry. (Winteringham, 1962).
499 Isotope methods. (Smith, 1963).

ADDENDUM

NEMATODES

A Radioisotope Studies

1586 Бодрова, И.М. ОСОБЕННОСТИ ФИЗИОЛОГИЧЕСКИХ ПРОЦЕССОВ И ВЛИЯНИЕ ЭЛЕМЕНТОВ ПИТАНИЯ НА РОСТ И РАЗВИТИЕ РАСТЕНИЙ, ЗАРАЖЕННЫХ ГАЛЛОВОЙ НЕМАТОДОЙ. Стр. 76-88 в сб. "Труды Всесоюзного института защиты растений", №16. 1961. Р. Ж. Биол. №13Г108. 1962.

Bodrova, I.M. FEATURES OF THE PHYSIOLOGICAL PROCESSES AND THE EFFECT OF THE NUTRITIVE ELEMENTS ON THE GROWTH AND DEVELOPMENT OF PLANTS INFECTED WITH GALL NEMATODES. Trudy. vsesoyuz. Inst. Zash. Rast. 16 (1961) 76-88. R. Zh. Biol. No. 13 G108. 1962.

Pot-experiment studies were made on the effect of increased amounts of N, P, and K on the resistance of plants to gall nematodes (Meloidogyne sp.). In plants thus infected, respiration, photosynthesis, and transpiration were more intense than in healthy plants. The intake of P^{32} by the infected plant and its distribution throughout the plant body was slower during the 1st period of development than in healthy plants, regardless of the amounts of N and P furnished in the nutrient solution. Infected plants had a higher content of sugars in the leaves and fruits, which reduced N, especially protein N. The fruit of infected plants contained less dry matter than did those of healthy plants. (BA 42: 1963, 15 551).

1587 Nicholas, W.L., Dougherty, E.C., Hansen, E.L., Holm-Hansen, O., Moses, V. THE INCORPORATION OF ^{14}C FROM SODIUM ACETATE-2- C INTO THE AMINO ACIDS OF THE SOIL-INHABITING NEMATODE, Caenorhabditis briggsae. J. exp. Biol. 37, 3 (1960) 435-43.

The nematode C. briggsae was cultured in a sterile culture medium consisting of a chick embryo extract, a liver extract and sodium acetate-2-C^{14}. Large numbers of worms and their eggs were collected from the cultures and reduced very largely to protein. The protein was hydrolysed and the constituent amino acids studied by chromatography and radioautography. Aspartic acid, glutamic acid, alanine, proline, glycine, serine and cysteic acid were found labelled with C^{14}. In addition to these, the following amino acids were identified in the chromatograms: histidine, lysine, methionine, arginine, threonine, tyrosine, valine and the combined spot for leucine, isoleucine and phenylalanine. The bearing of these results on the nutritional requirements of the nematode is discussed. (Auth.).

B Radiation Studies

1588 Brande, J. van den, Pelerents, C. SOME EFFECTS OF GAMMA RAYS ON MEAL WORMS AND VARIOUS NEMATODES. Soils & Fert. 26, 4 (1963) 276.

Data on the effect of γ- rays on free-living and root nematodes indicate that a minimum dose of 80 000 rad to 60 cm depth would be required for an effect comparable with that of the usual nematocides, making this method of control impracticable.

1589 Fassuliotis, G. OBSERVATIONS ON THE BIOLOGICAL EFFECTS OF IONIZING RADIATIONS ON THE LIFE CYCLE OF Heterodera rostochiensis WOLLENWEBER, 1923. Diss. Abstr. 22, 2 (1961) 401-2.

The biological effects of ionizing radiations were investigated on the golden nematode H. rostochiensis, a parasite of potatoes and tomatoes. The resistant stage, the cyst, containing several hundred embryonated eggs, was irradiated at a dose of 1000 r/min x-rays. Cysts were also irradiated with a Co^{60}-source emitting 670 000 r/h; moist cysts were treated at room temperature with dosages ranging from 5 through to 1280 kr. A delay of larval emergences was noted after 160 kr and above, which also resulted in a significant decrease in total hatch. A differential radiosensitivity among embryonated eggs within the cysts is indicated. No larvae hatched from cysts (maintained at 40°F) after a dose of 640 kr. A disturbance in the normal pattern of motility of emerged larvae in the form of slight jerkiness was first noted after 80 kr. After 20 kr, the infective capacity of the larva is decreased significantly. This trend continues. A few larvae were able to penetrate after 320 kr. Oviposition was not significantly affected up to 20 kr. After 20, 40 and 80 kr, eggs in females developing from irradiated larvae contained 16, 2 and 0% embryonated eggs. However, no larvae hatched from the 20 and 40 kr females. Viability was not altered in developing females after 6 months-postirradiation-storage at 40°F. Parthenogenesis does not occur in this nematode. There are indications that the presence of sperm is essential for the release and maturation of the oöcytes. The rate of colour changes (white females to brown cysts) is affected by irradiation. A diploid number of 18 chromosomes has been counted in the oöcytes. Chromosome aberrations were found in eggs recovered from females that developed from irradiated larvae. These were in the form of fragments and bridges at anaphase.

1590 Lackey, J.B. RATES, AMOUNTS, NUCLIDE ORIGIN AND EFFECTS OF RADIATION ACQUIRED BY FRESH-WATER AND SALT-WATER MICROORGANISMS UNDER EXPERIMENTAL CONTROL. (Abstr. E1C110). p.120 in "Research and Development in Progress. Biology and Medicine. Issue No. 1". TID-4200, Division of Technical Information, AEC. July 1963.

The effects of radioactivity from whatever source, radioisotopes or reactor, upon freshwater and marine microscopic organisms, are being evaluated. Among the animals investigated are nematodes. (From abstr.).

1591 Скарбилович, Т.С. ВЛИЯНИЕ ГАММА-ЛУЧЕЙ Co^{60} И ВЫСОКОВОЛЬТНЫХ ИМПУЛЬСОВ ЭЛЕКТРИЧЕСКОГО ТОКА НА ГАЛЛОВУЮ НЕМАТОДУ. Стр. 231-46 в сб. "Труды Всесоюзного института гельминтологии им. Скрябина", т.8. 1960.

Skarbilovich, T.S. p.231-46 in "Transaction of the Scryabin All-Union Institute of Helminthology, Vol.8". 1960.

Effect of Co^{60} gamma rays and high-voltage pulses on the gall nematode.

1592* Weischer, G. ACTIVATION AND SENSITIVITY TO IRRADIATION OF THE POTATO ROOT EELWORM. Mitt. biol. BdAnst. Land Forstw., Berlin-Dahlem 99 (1960) 59-65. (In German).

Heterodera rostochiensis larvae from 1-year-old cysts were more resistant to irradiation with Ra than those from 3-month-old cysts. Gonads of larvae activated by root diffusate were much more sensitive to irradiation than those of larvae in anabiosis. The degree of sensitivity seemed to depend mainly on the depth of dormancy, and not on age. (CA 55:1961, 25067i).

See also:

1468 Quelques effets des rayons gamma sur la teigne de la farine et sur divers nématodes. (Brande and Pelerents, 1962).

TABLES

TABLE 1

DISPERSAL OF RADIOISOTOPE-MARKED INSECTS

Insect	Label	Average	Maximum	Ref. No.
Aëdes taeniorhynchus	P^{32}	< 4 miles ♀	2 miles ♂ 18 miles ♀	66
Anopheles gambiae	P^{32}, S^{35}	mean flight range 0,64 mile ♀ 0,52 mile ♂ dispersion 0,98 mile ♀	2,25 miles ⚥	70
Ceratitis capitata	P^{32}		1400 yd 315 m (after 3 d)	72 95
Chrysomyia sp.	P^{32}		0,5 mile	100
Cnephalia cinerascens	P^{32}		18 - 20 km	82
Dacus oleae	P^{32}		4,3 km ** 2 km *	86 88
Drosophila melanogaster	P^{32}		4,4 miles upwind	101
Eurygaster integriceps	Co^{60}	0,5 - 1 km/d (Aug.)	15 km	89
Eurytoma roddi	P^{32}, S^{35}		4100 ft downwind	97
Flies (including Musca domestica)	P^{32}		330 ft 250 m 0,5 mile	84 68 100
Hadena sordida	P^{32}		3 km ♂ 2 km ♀	82
Haematobia irritans	P^{32}		5 miles	65
Musca domestica (see also flies)	P^{32}		5 miles	65
Nomophila noctuella	mixed fission products		1500 miles	73
Stomoxys calcitrans	P^{32}		1 - 5 miles (5 miles in < 2 h)	65
Wohlfartia magnifica	P^{32}		2000 yd	99
Xenopsylla	S^{35}		100 m	140

* sunny winter's day ** autumn; special conditions

TABLE 2

RADIATION-INDUCED STERILIZATION OF INSECTS

	Insect	Stage	Radiation	Sterilizing Dose	Ref. No.
1.	Acanthoscelides obsoletus (Bean weevil)	A ?	γ	20 000 rad	1498-9
2.	Aëdes aegypti (Yellow-fever mosquito)	P	γ	11 000 - 18 000 r	1444
3.	Anastrepha ludens (Mexican fruit fly)	$P_{12\,d}$	x	5000 r	811, 1434
4.	Anopheles maculipennis atroparvus	A	x	6000 r	1342
5.	Anopheles quadrimaculatus	$P_{24\,h}$ P A	γ γ γ	12 000 r 8865 - 12 900 r 8865 - 12 900 r	1446 1180 1180
6.	Anthonomus grandis (Boll weevil)	A	γ	15 000 r	774
7.	Attagenus piceus (Black carpet beetle)	?	γ	slightly < 15 000 rad	1493
8.	Blattella germanica (German cockgroach)	N	γ	3200 r	1354
9.	Callosobruchus chinensis	A ⚥ emerged overnight	γ	42 000 rad	1285
10.	Carpocapsa pomonella (Codling moth)	P ♂ 1 d before emergence ♀	γ γ	40 000 rad * 25 000 rad **	1463-4 1463-4
11.	Ceratitis capitata (Mediterranean fruit fly)	P P_{mature}	γ γ	10 000 - 13 000 r 10 000 r	1452 1227
12.	Chloridea obsoleta	P ♂	γ	8000 r	1475
13.	Cochliomyia hominivorax (Screwworm)	$P_{5\,d}$ P ♀	γ γ/CO_2 γ/CO_2+air γ/CO_2+air	7500 r 11 000 r 4500 r 5500 - 6200 r	1440 1045 1075 1045
14.	Culex fatigans	P	γ	7700 r	1447
15.	Dacus cucurbitae (Melon fly)	P_{mature}	γ	10 000 r	1227

A = adult; L = larva; N = nymph; P = pupa (suffix indicates age); * 98% sterility ** > 99% sterility

TABLE 2 (cont'd)

	Insect	Stage	Radiation	Sterilizing Dose	Ref. No.
16.	Dacus dorsalis (Oriental fruit fly)	P_{mature}	γ	10 000 r	1227
17.	Dacus oleae (Olive fly)	P P A	γ γ γ	8000 - 12 000 r 11 000 - 15 000 rad 15 000 - 18 000 rad	1459 815 815
18.	Diatraea saccharalis (Sugarcane borer)	$P_{<3d}$ ⚥	γ	> 15 000 r	1434
19.	Drosophila melanogaster	L ♂ P ♂ A ♂	γ γ γ	5000 r 10 000 - 20 000 r 2000 r ǂ	1434 1434 1434
20.	Ephestia cautella (Almond moth)	P		> 16 000 rad	805
21.	Ephestia kühniella (Mediterranean flour moth)	P ♂ P_{3d} ♂ P_{6d} ♂ P_{15d} P ♀ P ♂ A ?	γ γ γ γ γ γ γ	60 000 rad > 10 000 rad 30 000 rad 60 000 rad 25 000 rad 45 000 rad 16 000 rad	804 1235 1235 1235, 1468 1237 1237 1499
22.	Gnathocerus cornutus	A ?	γ	8000 rad	1498-9
23.	Habrobracon	A ?	Pu^{239}	0,11 - 0,14 μc	1414
24.	Ips confusum (Bark beetle)	A ⚥ ?	γ	< 10 000 r	1382
25.	Lasioderma serricorne (Cigarette beetle)	A A ?	γ γ	16 000 rad slightly < 15 000 rad	805 1493
26.	Lucilia sericata (Sheep maggot fly)	P ♂ ♀	γ γ	> 3000 rep 3000 rep	1327 1327
27.	Melolontha vulgaris (White grub)	A	x	(3000 - 5000 r)	1437
28.	Musca domestica (Housefly)	P P	x ?	3000 r 2000 r	812 1450
29.	Paramyelois transitella (Navel orangeworm)	P ⚥	γ	50 000 rad	1470

ǂ Effective 10 d after irradiation

TABLE 2 (cont'd)

	Insect	Stage	Radiation	Sterilizing Dose	Ref. No.
30.	Plodia interpunctella (Indian meal moth)	? ?	γ γ	> 16 000 rad 50 000 rad	805 1493
31.	Pyrausta (ostrinia) nubilalis (Corn borer)	A_{1d} ♂	γ	32 000 r	1434, 1473
32.	Rhizopertha dominica (Lesser grain borer)	A	γ	12 000 rad 16 000 rad	1499 805
33.	Sitophilus granarius (Grain weevil)	A A ? A A	γ γ/ temp. γ	≥ 5000 rad 16 000 rad 8000 r 10 000 rad 16 000 rad	1371 1479 761 1498-9 1103, 1228
34.	Sitophilus oryzae (Rice weevil)	A A A	x γ γ	7500 - 10 000 r ≥ 5000 rad 16 000 rad	1256 1371 1228
35.	Sitophilus sasakii	A	γ	15 000 r	1497
36.	Spodoptera exigua (Beet armyworm)	P ♂ P ♀	γ γ	9000 - 11 000 r 5000 r	810 810
37.	Tenebrio molitor (Yellow mealworm)	L	γ	8000 rad	1498-9
38.	Thaumetopoea pithyocampa (Pine processionary moth)	P_{15d}	γ	4000 r	1462
39.	Tribolium (Flour beetle)	A ?	γ	slightly > 12 000 rad	1498-9
40.	Tribolium castaneum (Red rust flour beetle)	A A	x γ	6000 r 16 000 rad*	1372, 1414 772
41.	Tribolium confusum (Confused flour beetle)	A A A	x γ γ	6000 r < 10 000 rad 16 000 rad	1372, 1414 1493 1228
42.	Trogoderma granarium (Khapra beetle)	P ♂ P ♂ P ♀ A ?	γ γ γ γ	15 000 r 16 000 rad 6000 rad 15 000 rad	789 1275 1275 1493

* 90% mortality

TABLE 3

RADIOTRACER STUDIES ON INSECTICIDES [1, 2]

Data have been assembled in the following categories:

- B. BOTANICALS AND DERIVATIVES
- C. CHLORINATED ARYL HYDROCARBONS (containing 6 or more chlorines)
- D. DDT RELATIVES (diphenyl aliphatics)
- F. FUMIGANTS
- H. HETEROCYCLIC COMPOUNDS (not to be found elsewhere)
- P. PHOSPHORUS-CONTAINING COMPOUNDS
  - A. ALIPHATIC DERIVATIVES
  - C. ARYL (PHENYL) DERIVATIVES
  - H. HETEROCYCLIC DERIVATIVES
- R. RADIOMIMETIC AGENTS. CHEMOSTERILANTS
- S. SULFONATES
- X. CARBAMATES
- Z. MISCELLANEOUS

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[1] Chemical names and "other designations" for compounds cited in the bibliography are largely based on E.E. Kenaga's "Commercial and Experimental Organic Insecticides" (1963 Revision) in Bull. ent. Soc. Am. 9, 2 (1963) 67-103 (with the exception of Baycid, Iridomyrmecin, malaoxon, metaphos, methyl paraoxon and pentachlorophenol). The chemical categories have been maintained, apart from slight modifications. Two indexes (i) Common and Manufacturers' Names Index, and (ii) Letter-and-Number Index (the latter differing somewhat from the separate Number and Letter Indexes of the article) have also been prepared.

[2] The chemical name used in accordance with the principles of Chemical Abstracts nomenclature is generally marked with an asterisk, *.

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis*	Metabolism	Residue determination
BOTANICALS AND DERIVATIVES					
B.1	rotenone (from plant species Derris and Lonchocarpus)	rotenone powder and resins derris cubé	C^{14}(599)	insects C^{14}(495)	
B.2	* pyrethrum (principally from plant species Chrysanthemum cinariaefolium)	pyrethrum pyrethrin I pyrethrin II	pyrethrum C^{14}(598) pyrethrin C^{14}(596-7)	Musca domestica C^{14}(596)	
CHLORINATED ARYL HYDROCARBONS (containing 6 or more chlorines)					
C.1/2	benzene hexachloride * 1,2,3,4,5,6-hexachlorocyclohexane, mixed isomers hexachlorocyclohexane 1,2,3,4,5,6-hexachlorocyclohexane, 99% or more gamma isomer * lindane	BHC HCH 666 gammexane lindane gamma BHC	Isomer determination Cl^{36} α- (532, 1547) δ- (539) Isomerization C^{14}(533)	animals C^{14}, Cl^{36}(540) Cl^{36}(538, 540) rat C^{14}, Cl^{36}(664) cattle Cl^{36}(706) Periplaneta americana C^{14}(534) cuticle penetration C^{14}(534) plants C^{14}(536) rice C^{14}(536-7, 698) girdling experiments, woody plants C^{14}(541)	cattle (meat) C^{14}(706) neutron activation analysis (1550)

* If no other indication

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
C.3	1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane * chlordan 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene 1,2,4,5,6,7,10,10-octachloro-4,7,8,9-tetrahydro-4,7-endo-methyleneindane	chlordane Octa-Klor Octachlor Velsicol 1068 1068	C^{14} (526, 529)	Aëdes aegypti C^{14} (526, 529) fungi C^{14} (526, 529) rat C^{14} (526, 529)	
C.4	1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene * heptachlor 1(3a),4,5,6,7,8,8-heptachloro 3a(1),4,7,7a-tetrahydro-4,7-methanoindene 1,4,5,6,7,10,10-heptachloro 4,7,8,9-tetrahydro-4:7 endomethyleneindene 4,5,6,7,9,10,10-heptachloro 4,7,8,9 tetrahydro-4,7-methanoindene	heptachlor Velsicol 104 E-3314	C^{14} (526, 529)	Aëdes aegypti C^{14} (526, 529) fungi C^{14} (526, 529) rat C^{14} (526, 529)	
C.5	not less than 95% of 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-endo-exo-5,8-dimethanonaphthalene * aldrin	aldrin compound 118 Octalene HHDN	C^{14} (524, 526, 529, 530)	Aëdes aegypti C^{14} (525-6) fungi C^{14} (525-6) Musca domestica C^{14} (620) Periplaneta americana C^{14}, Cl^{36} (654) rat C^{14} (525-7, 660) Schistocerca gregaria Cl^{36} (621)	film Cl^{36} (720)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
C.6	not less than 85% of 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-exo-5,8-dimethanonaphthalene * dieldrin	dieldrin compound 497 Octalox HEOD		Aëdes aegypti C^{14} (525-6) Anopheles gambiae C^{14} (522) fungi C^{14} (526) mouse Cl^{36} (523) Musca domestica C^{14} (522)	butterfat C^{14} (709)
C.7	* decachlorooctahydro-1,3,4-metheno-2H-cyclobuta [cd] pentalen-2-one decachlorotetracyclo decanone 1,2,3,5,6,7,8,9,10,10-decachloro-tetracyclo (5.2.1.$0^{2,6}$.$0^{3,9}$.$0^{5,8}$)-decane-4-one decachlorotetrahydro-4,7-methanoindeneone 2,3,3a,4,5,6,7,7a,8,8a-decachloro-3a,4,7,7a-tetrahydro-4,7-methanoinden-1-one	1189 Kepone			milk Cl^{36} (708)
C.8	* 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin 3-oxide	endosulfan Thiodan BIO-5462 Hoe 2671 Malix Niagara 5462		Calandra granaria S^{35} (549) Musca domestica C^{14} (656) Periplaneta americana S^{35} (548)	

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis*	Metabolism	Residue determination
C.9	* 1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan	Telodrin SD 4402 CP-14957	C^{14} (526, 547)	Aëdes aegypti C^{14} (526, 547, 655) fungi C^{14} (526, 547) Laphygma frugiperda C^{14} (653) rat C^{14} (526, 547)	
DDT RELATIVES					
D.1	dichloro diphenyl trichloroethane * 1,1,1-trichloro-2,2-bis-(p-chlorophenyl) ethane	DDT Chlorophenothene	Properties C^{14} (543)	Aëdes aegypti C^{14} (380, 622, 624, 733) Anthonomus grandis C^{14} (628) Blattella germanica C^{14} (207, 627) cattle C^{14} (658, 705-6) Drosophila melanogaster C^{14} (544) Heliothis zea Cl^{36} (626) Musca domestica C^{14} (207, 428) Pectinophora gossypiella C^{14} (623) Pediculus humanus humanus C^{14} (629) Periplaneta americana C^{14} (207, 428) rat C^{14} (545) Salmo salar salar C^{14} (668) Salmo trutta C^{14} (667) soil sorption C^{14} (733-4) Triatoma infestans C^{14} (625)	milk C^{14} (658, 704, 708) neutron activation analysis (1550)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
D.2	* 1,1,1-trichloro-2,2-bis-(p-methoxyphenyl) ethane dianisyl trichloroethane	methoxychlor Methoxy DDT DMDT Marlate		cattle C^{14} (704)	milk C^{14} (704) spinach C^{14} (731)
D.3	1,1-bis (p-chlorophenyl) 2,2,2-trichloroethanol * 4,4'-dichloro-α-(trichloromethyl) benzhydrol 1,1,1-trichloro-2-hydroxy-2,2-bis (p-chlorophenyl) ethane	Kelthane FW-293		Drosophila melanogaster C^{14} (544)	
FUMIGANTS					
F.1	1,2-dibromo-3-chloropropane	Fumazone Nemagon OS 1897			neutron activation analysis (1548)
F.2	methyl bromide * bromomethane	CH_3Br MeBr Meth-O-Gas	C^{14} (511)		packaging material C^{14} (510-11) rice C^{14} (510-11) soybeans C^{14} (510-11) wheat Br^{82} (732)
F.3	sulfuryl fluoride	Vikane	S^{35} (511)	Kalotermes minor S^{35} (517)	analysis S^{35} (511)
F.4	naphthalene			Musca domestica C^{14} (513-6, 635) rat C^{14} (516)	

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis*	Metabolism	Residue determination
F. 5	hydrogen cyanide * hydrocyanic acid	HCN prussic acid (in H_2O)	C^{14} (1551)	Linum usitatissimum C^{14} (508) Schistocerca gregaria C^{14} (505) Sitophilus granarius C^{14} (505-7)	
F. 6	* carbon disulfide carbon bisulfide	CS_2	S^{35} (520)		
F. 7	sulfur dioxide	SO_2		Douglas fir S^{35} (518) spinach S^{35} (519)	
HETEROCYCLIC COMPOUNDS					
H. 1	* nicotine 1-1-methyl-2-(3-pyridyl)-pyrrolidine 1-3-(1-methyl-2-pyrrolidyl)-pyridine	Black Leaf (40) nicotine (sulfate)	H^3 (605) C^{14} (601-4) Degradation C^{14} (600)		
PHOSPHORUS-CONTAINING COMPOUNDS PHOSPHORUS ALIPHATIC DERIVATIVES					
P/A. 1	* O,O,O',O'-tetraethyl S,S'-methylene bisphosphorodithioate [bis(S-diethoxyphosphinothioyl)-mercapto] methane	ethion Nialate Niagara 1240	P^{32} (567)		

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/A. 2	* dimethyl (2,2,2-trichloro-1-hydroxyethyl) phosphonate	Dipterex Bayer L13/59 Dylox Neguvon chlorophos trichlorofon Tugon Dipteres	P^{32} (591)	cattle P^{32} (592, 658, 674, 679) Musca domestica P^{32} (618) poplar P^{32} (697) rabbit P^{32} (658)	
P/A. 3	O,O-dimethyl 2,2-dichlorovinyl phosphate * 2,2-dichlorovinyl dimethyl phosphate	DDVP Herkol Vapona dichlorvos	P^{32} (591)	cattle P^{32} (682) corn P^{32} (682) cotton P^{32} (682) goat P^{32} (682) rabbit P^{32} (683) rat C^{14} (682-3) P^{32} (682)	
P/A. 4	* 3-(dimethoxyphosphinyloxy)-N,N-dimethyl-cis-crotonamide 2-dimethylcarbamoyl-1-methylvinyl dimethyl phosphate dimethyl phosphate of 3-hydroxy N,N-dimethyl-cis-crotonamide	Bidrin SD 3562		Anthonomus grandis C^{14}, P^{32} (619) beans C^{14}, P^{32} (554) cotton C^{14}, P^{32} (619) Heliothis zea C^{14}, P^{32} (619) mammals C^{14}, P^{32} (554)	

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis*	Metabolism	Residue determination
P/A. 5	* 2-chloro-2-diethylcarbamoyl-1-methylvinyl dimethyl phosphate 1-chloro-1-diethylcarbamoyl-1-propen-2-yl dimethyl phosphate	phosphamidon ML-97 OR-1191 Dimecron	C^{14} (575-6)	beans C^{14} (576)	
P/A. 6	1,2-dibromo-2,2-dichloroethyl dimethyl phosphate	naled DIBROM RE 4355		cattle P^{32} (682) rat P^{32} (682)	
P/A. 7	* O,O-diethyl S-ethylthiomethyl phosphorodithioate O,O-diethyl S-ethylmercaptomethyl dithiophosphate	phorate Thimet L 11/6 AC 3911		barley P^{32} (585) cotton P^{32} (687, 691-2)	cotton P^{32} (724)
P/A. 8	O,O-diethyl O (and S)-2-(ethylthio) ethyl phosphorothioates * mixture of O,O-diethyl S- (and O) 2-(ethylthio) ethyl phosphorothioates mixture of O,O-diethyl S-ethyl-mercaptoethyl thiophosphate and O,O-diethyl O-ethylmercaptoethyl thiophosphate a trialkyl thiophosphate	demeton Systox E-1059 Bayer 8173 mercaptophos	(intermediate) C^{14}, S^{35} (555)	market-gardening produce P^{32} (690) Vitis vinifera P^{32} (695) pineapple S^{35} (696)	P^{32} (717) crops (various) P^{32} (718)
P/A. 9	* O,O-diethyl S-2-(ethylthio)-ethyl phosphorodithioate	Bayer 19639 Di-Syston Ekatine dithiodemeton		cotton P^{32} (694) pineapple S^{35} (696)	

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/A. 10	* O,O-dimethyl dithiophosphate of diethyl mercaptosuccinate O,O-dimethyl S-(1,2-dicarbethoxyethyl) dithiophosphate S-[1,2-bis(ethoxycarbonyl)-ethyl] O,O-dimethyl phosphorodithioate O,O-dimethyl phosphorodithioate ester with diethyl mercaptosuccinate	malathion Malathon 4049	S^{35} (677)	Aëdes aegypti P^{32} (640) Blattella germanica P^{32} (666) cattle P^{32} (676) Culex tarsalis P^{32} (637, 639, 641-2) forest ecosystem S^{35} (677) mouse P^{32} (666) Musca domestica P^{32} (56, 637, 666) Periplaneta americana P^{32} (638, 666) rice P^{32} (699)	milk P^{32} (676)
P/A. 11	O,O-dimethyl thiophosphate of diethyl mercaptosuccinate	malaoxon		Culex tarsalis P^{32} (636, 642)	
P/A. 12	O,O-dimethyl S(N-methylcarbamoylmethyl) phosphorodithioate * S-methylcarbamoylmethyl O,O-dimethyl phosphorodithioate O,O-dimethyl S-α-mercapto-N-methylacetamido dithiophosphate methyl dimethyl dithiophosphoryl acetamide	dimethoate Cygon Rogor AC 12880 ENT 24650 NC-262		Aëdes aegypti P^{32} (646) Anopheles quadrimaculatus P^{32} (646) Anopheles taeniorhynchus P^{32} (646) Aphis fabae P^{32} (565) Blattella germanica P^{32} (556)	beets (sugar-, fodder-) P^{32} (729) olive (fruit) P^{32} (727) peach P^{32} (729)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/A. 12				cherries P^{32} (729) Chrysomphalus dicytospermi P^{32} (561) citrus plant P^{32} (559) cocoa plant P^{32} (685) cotton P^{32} (560, 688-9, seedling 693) Heliothis zea P^{32} (632) lemon P^{32} (558, 563, 566) mouse P^{32} (557, 666) Musca domestica P^{32} (556) olive (fruit) P^{32} (564) peach P^{32} (562) Periplaneta americana P^{32} (428, 556) pineapple S^{35} (696) potato P^{32} (560) rat P^{32} (557) sheep P^{32} (673)	

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/A. 13	bis(dimethylamino) fluorophosphine oxide * tetramethylphosphorodiamidic fluoride	dimefox DMF Hanane Pestox 14 Terra Sytam		Vitis vinifera P^{32} (695)	P^{32} (717)
P/A. 14	* octamethylpyrophosphoramide bis(dimethylamino) phosphoric anhydride bis-N, N, N', N'-tetramethylphosphorodiamidic anhydride tetrakisdimethylaminophosphonous anhydride	schradan OMPA Pestox III Sytam		Chilo suppressalis P^{32} (651-2) cotton P^{32} (686) Dysdercus koenigii P^{32} (582) Leptocorisa varicornis P^{32} (651-2) Musca domestica P^{32} (651-2) Nephotettix bipunctatus cincticeps P^{32} (651) Periplaneta americana P^{32} (650-2) Scotinophara lurida P^{32} (651-2) sugarcane P^{32} (686) Vitis vinifera P^{32} (695)	
PHOSPHORUS PHENYL (CARBOCYCLIC) DERIVATIVES					
P/C. 1	O,O-dimethyl O-p-nitrophenyl phosphate	methyl para-oxon		Chilo suppressalis P^{32} (643) guinea pig P^{32} (643) Periplaneta americana P^{32} (643) rabbit P^{32} (643) rat P^{32} (643) Xylotrupes dichotomus P^{32} (643)	cotton P^{32} (726)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Properties	Metabolism	Residue determination
P/C. 2	* O,O-dimethyl O-p-nitrophenyl phosphorothioate O,O-dimethyl O-p-nitrophenyl thiophosphate dimethyl p-nitrophenyl thionophosphate dimethyl p-nitrophenyl phosphorothionate	methyl parathion methyl homologue of parathion Nitrox Bayer E-601 Metron	P^{32} (574)	Chilo suppressalis P^{32} (643) cotton P^{32} (725-6) Blattella germanica P^{32} (584) guinea pig P^{32} (584, 643) Periplaneta americana P^{32} (643) rabbit P^{32} (643) rat P^{32} (584, 643) rice S^{35} (584, 699) Xylotrupes dichotomus P^{32} (643)	cotton P^{32} (725-6)
P/C. 3	O,O-diethyl O-p-nitrophenyl phosphate * diethyl p-nitrophenyl phosphate	para-oxon oxygen analogue of parathion Bayer E-600	P^{32} (573)	frog P^{32} (681) mouse P^{32} (572, 681) Musca domestica P^{32} (645) Periplaneta americana P^{32} (428, 572, 681)	
P/C. 4	O,O-diethyl O-p-nitrophenyl phosphorothioate * parathion O,O-diethyl O-p-nitrophenyl thiophosphate diethyl p-nitrophenyl thionophosphate diethyl p-nitrophenyl phosphorothionate	parathion Alkron Niran Thiophos Amer. Cyan. 3422 Bayer E-605	P^{32} (573-4, 734)	Aëdes aegypti P^{32} (646) Aëdes taeniorhynchus P^{32} (646) Anopheles quadrimaculatus P^{32} (646) cat P^{32} (678, 680)	man P^{32} (678, 716)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Properties	Metabolism	Residue determination
P/C. 4				Epilachna varivestis P^{32} (644) guinea pig P^{32} (680) mouse P^{32} (572, 679) Musca domestica P^{32} (645) Oncopeltus fasciatus P^{32} (644) Periplaneta americana P^{32} (572) Prodenia eridania P^{32} (644) rabbit P^{32} (678, 680) rat P^{32} (678) Scanninoidea exitiosa P^{32} (644)	
P/C. 5	mixture of parathion and methyl parathion	metaphos		guinea pig P^{32} (680)	
P/C. 6	O,O-diethyl O-(3-methyl-4-methylthiophenyl) thiophosphate	Baycid		rice P^{32} (551)	agricultural products P^{32} (719)
P/C. 7	O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate * O,O-dimethyl O-(4-nitro-m-tolyl) phosphorothioate	Folithion Bayer 41831 Sumithion Sumitomo S-1102A	S^{35} (583)	Blattella germanica P^{32} (584) guinea pig P^{32} (584) rat P^{32} (584) rice P^{32} (584)	apples P^{32} (552) oranges P^{32} (552) radishes P^{32} (552) sugar beet P^{32} (552)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/C. 8	* O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate	ronnel Dow ET-57 Dow ET-14 Korlan Nankor Trolene Etrolene Fenchlorphos		Cimex lectularius P^{32} (586) Leucophaea maderae P^{32} (648) rabbit P^{32} (586)	
P/C. 9	* O-4-tert-butyl-2-chlorophenyl O-methyl methylphosphoramidate	Dowco 132 Ruelene		insects P^{32} (649)	milk P^{32} (708) poultry P^{32} (712)
P/C. 10	* O,O-dimethyl O-[4-(methylthio)-m-tolyl]phosphorothioate O,O-dimethyl O-(3-methyl, 4-methylmercaptophenyl) phosphorothioate O,O-dimethyl O-4-(methylmercapto) 3-methylphenyl thiophosphate	Baytex Bayer 29493 S 1752 ENT 25540 Entex Tiguvon Lebaycid fenthion		Anopheles albimanus P^{32} (569) Anthonomus grandis P^{32} (661) Blattella germanica P^{32} (661) cabbage P^{32} (700) cotton P^{32} (569) Culex pipiens quinquefasciatus P^{32} (569) Musca domestica P^{32} (569, 661) Periplaneta americana P^{32} (553) rat P^{32} (553, 661) tea P^{32} (700) turnips P^{32} (723)	beans P^{32} (570, 723) milk P^{32} (661) olives P^{32} (730)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/C. 11	ethyl ester of O,O-dimethyl-dithiophosphoryl α-phenyl acetic acid * ethyl (dimethoxyphosphinothioylthio) phenylacetate	Dimephenthoate Cidial			P^{32} (721)
P/C. 12	* O-p-(dimethylsulfamoyl) phenyl O,O-dimethyl phosphorothioate	Famophos CL 38023		insects H^3 (568) mammals H^3 (568)	
P/C. 13	* 2-chloro-1-(2,4-dichlorophenyl)-vinyl diethyl phosphate	SD-7859 Compound 4072		cattle P^{32} (675, 707)	milk P^{32} (707)
	PHOSPHORUS HETEROCYCLIC DERIVATIVES				
P/H. 1	O,O-diethyl O-3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl phosphorothioate * O-(3-chloro-4-methylumbelliferone) O,O-diethyl phosphorothioate O,O-diethyl O-(3-chloro-4-methyl-7-coumarinyl) phosphorothioate 3-chloro-4-methylumbelliferone, O,O-diethyl thiophosphate	Bayer 21/199 CO-RAL Muscotox		livestock P^{32} (666) poultry P^{32} (713-4) rat P^{32} (666)	milk P^{32} (708)
P/H. 2	* S-[(5-methoxy-4-oxo-4H-pyran-2-yl) methyl] O,O-dimethyl phosphorothioate 5-methoxy-2 (dimethoxy phosphinylthiomethyl) pyrone 4	endothion Nia 5767 AC-18737 phosphate 100			market-gardening produce S^{35} (690)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/H. 3	O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidyl) thiophosphate * O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate	diazinon Basudin G-24480		bacterial and protozoan response C^{14} (672) dog P^{32} (671) guinea pig P^{32} (670) Musca domestica P^{32} (631, 666)	
P/H. 4	* O,O-diethyl O-2-pyrazinyl phosphorothioate	EN 18133 Zinophos Nemaphos Cynem			bananas C^{14} (722)
P/H. 5	* O,O-dimethyl S-4-oxo-1,2,3-benzotriazin-3(4H)-ylmethyl phosphorodithioate O,O-dimethyl S-(4-oxo-3H-1,2,3-benzotriazine-3-methyl)-phosphorodithioate O,O-dimethyl-S-(benzaziminomethyl) dithiophosphate S-(3,4-dihydro-4-oxo-1,2,3-benzotriazin-3-ylmethyl) O,O-dimethyl phosphorodithioate benzotriazine derivative of a methyl dithiophosphate 3-(mercaptomethyl) 1,2,3-benzotriazin-4-(3H)-one O,O-dimethyl phosphorothioate	Guthion Gusathion Bayer 17147 17/147 Bayer 9027 AZINPHOS-methyl		cotton P^{32} (725)	cotton P^{32} (725)

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/H. 6	naphthaloximido-O,O-diethyl phosphorothioate * O,O-diethyl O-naphthalimido phosphorothioate	Bayer 22408 ENT 24970		Aëdes aegypti P^{32} (646) Aëdes taeniorhynchus P^{32} (646) Anopheles quadrimaculatus P^{32} (646) cattle P^{32} (662-3, 708) guinea pig P^{32} (663) sheep P^{32} (578) Stomoxys calcitrans P^{32} (662)	milk P^{32} (662, 708)
P/H. 7	phthalimidomethyl O,O-dimethyl phosphorodithioate * O,O-dimethyl S-phthalimidomethyl phosphorodithioate	Imidan Prolate R-1504		insects C^{14} (633)	
P/H. 8	* N-hydroxynaphthalimide diethyl phosphate	Bayer S-940 Bayer 9002 Bayer 25820 ENT-25567		cattle P^{32} (663) guinea pig P^{32} (663)	
	RADIOMIMETIC AGENTS. CHEMOSTERILANTS				
R. 1	* tris(1-aziridinyl) phosphine oxide	tepa aphoxide ENT. 24915 APO		Aëdes aegypti (1180, 1378) Anopheles quadrimaculatus (1180)	
R. 2	* tris[1-(2-methylaziridinyl)] phosphine oxide	metepa metaphoxide ENT. 50003 MAPO methyl aphoxide		Aëdes aegypti P^{32} (737) Anopheles quadrimaculatus P^{32} (737) Culex tarsalis P^{32} (736)	

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
R. 2				Callitroga hominivorax P^{32} (735, 737) mouse P^{32} (736) Musca domestica P^{32} (736-7) Stomyx calcitrans P^{32} (735-7)	
R. 3	2,2,4,4,6,6-hexahydro-2,2,4,4,6,6-hexakis(1-aziridinyl)-1,3,5,2,4,6-triazatriphosphorine * 2,2,4,4,6,6-hexakis(1-aziridinyl)-2,2,4,4,6,6-hexahydro-1,3,5,2,4,6-triazatriphosphorine hexakis (1-aziridinyl) phosphonitrile	apholate ENT. 26316 SQ 8388 OM 2174		Aëdes aegypti (1180, 1378) Anopheles quadrimaculatus (1180) Drosophila (1169, 1172, 1434)	
R. 4	* *N*-{*p*-[(2,4-diamino-6-pteridyl)methyl] methylaminobenzoyl} glutamic acid	methotrexate Amethopterin		Aëdes aegypti (1180) Anopheles quadrimaculatus (1180)	
			SULFONATES		
S. 1	* *p*-chlorophenyl *p*-chlorobenzenesulfonate	ovex CPCBS chlorfenson Chlorfensone Miticide K-101 Ovochlor Ovotran K-6,451 C-854 C-1006 Trichlorfenson		Panonychus citri S^{35} (542) Periplaneta americana S^{35} (542)	

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
			CARBAMATES		
X. 1	2-*n*-propyl-4-methylpyrimidyl(6) dimethylcarbamate * 6-methyl-2-*n*-propyl-4-pyrimidinyl dimethylcarbamate 4-methyl-2-propyl-6-pyrimidinyl dimethylcarbamate	Pyramat G 23330	C^{14} (612)		
X. 2	1-naphthyl *N*-methylcarbamate * 1-naphthyl methylcarbamate α-naphthyl *N*-methylcarbamate	Sevin 7744	C^{14} (612)	Blattella germanica C^{14} (611) Musca domestica C^{14} (606, 610, 611) Oncopeltus fasciatus C^{14} (611) Periplaneta americana C^{14} (610) rat C^{14} (606) beans C^{14} (606) cotton C^{14} (606)	
X. 3	* 4-dimethylamino-3,5-xylyl methylcarbamate	Zectran Dowco 139 ENT 25766	C^{14} (612)		
X. 4	* 4-(methylthio)-3,5-xylyl methylcarbamate	Bayer 37344 Bayer H-321 Bayer 9026 ENT-25726	C^{14} (612)		
X. 5	* *o*-isopropoxyphenyl methylcarbamate 2-isopropoxyphenyl methylcarbamate	Bayer 9010 Bayer 39007 Bayer H-5812315	C^{14} (612)		

TABLE 3 (cont'd)

	Chemical name	Other designations for chemical and its compositions	Synthesis*	Metabolism	Residue determination
	MISCELLANEOUS COMPOUNDS				
Z. 1	As^{74} As^{76}	arsenic	As^{74} (614)	insects As^{74} (494) insects As^{76} (494)	
Z. 2	sulfur		S^{35} (615) Properties S^{35} (616)		
Z. 3		Iridomyrmecin	C^{14} (526, 634)	Aëdes aegypti C^{14} (526, 634) cattle (beef liver) C^{14} (526, 634) fungi C^{14} (526) rat C^{14} (526, 634)	
Z. 4		pentachlorophenol	Cl^{36} (546)		

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* Only radiological applications have been grouped together. Due to bulk of pertinent references other x-ray applications are not summarized separately but the use of x-rays is indicated with each relevant study.

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INSECTICIDE INDEX

(i) COMMON AND MANUFACTURERS' NAMES INDEX

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aldrin	C.5	fenthion	P/C.10	Octachlor	C.3
Alkron	P/C.4	Folithion	P/C.7	Octa-Klor	C.3
Amethopterin	R.4	Fumazone	F.1	Octalox	C.6
apholate	R.3	gamma BHC	C.1,2	ovex	S.1
aphoxide	R.1	gammexane	C.1,2	Ovochlor	S.1
arsenic	Z.1	Gusathion	P/H.5	Ovotran	S.1
Azinophos methyl	P/H.5	Guthion	P/H.5	para-oxon	P/C.3
Basudin	P/H.3	Hanane	P/A.13	parathion	P/C.4
Baycid	P/C.6	heptachlor	C.4	pentachlorophenol	Z.4
Baytex	P/C.10	Herkol	P/A.3	Pestox III	P/A.14
Bidrin	P/A.4	Imidan	P/H.7	Pestox 14	P/A.13
Black Leaf 40	H.1	Iridomyrmecin	Z.3	phorate	P/A.7
chlordane	C.3	Kelthane	D.3	phosphamidon	P/A.5
chlorfenson	S.1	Kepone	C.7	phosphate 100	P/H.2
Chlorfensone	S.1	Korlan	P/C.8	Prolate	P/H.7
Chlorophenothene	D.1	Lebaycid	P/C.10	prussic acid	F.5
chlorophos	P/A.2	lindane	C.1,2	Pyramat	X.1
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Ekatine	P/A.9	Nankor	P/C.8	Tiguvon	P/C.10
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endothion	P/H.2	Nemagon	F.1	trichlorofon	P/A.2
Entex	P/C.10	Nemaphos	P/H.4	Trolene	P/C.8
ethion	P/A.1	Nialate	P/A.1	Tugon	P/A.2
Etrolene	P/C.8	nicotine (sulfate)	H.1	Vapona	P/A.3
Famophos	P/C.12	Niran	P/C.4	Vikane	F.3
Fenchlorphos	P/C.8	Nitrox	P/C.2	Zectran	X.3
				Zinophos	P/H.4

(ii) LETTER AND NUMBER INDEX

Letter/Number	Chemical classification code	Letter/Number	Chemical classification code
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AC 12880	P/A. 12	FW-293	D.3
AC 18737	P/H. 2	G-23330	X. 2
APO	R. 1	G-24480	P/H. 3
Amer. Cyanamide 3422	P/C. 4	HCH	C. 12
Bayer 8173	P/A. 8	HCN	F. 5
Bayer 9002	P/H. 8	Bayer H-321	X. 4
Bayer 9010	X. 5	Bayer H-5812315	X. 5
Bayer 9026	X. 4	HEOD	C. 6
Bayer 17147	P/H. 5	HHDN	C. 5
Bayer 19639	P/A. 9	Hoe 2671	C. 8
Bayer 22408	P/H. 6	K-6,451	S. 1
Bayer 25820	P/H. 8	L 11/6	P/A. 7
Bayer 29493	P/C. 10	Bayer L13/59	P/A. 2
Bayer 37344	X. 4	MAPO	R. 2
Bayer 39007	X. 5	ML-97	P/A. 5
Bayer 41831	P/C. 7	NC-262	P/A. 12
Bayer 21/199	P/H. 1	Nia 5767	P/H. 2
BHC	C. 1, 2	Niagara 1240	P/A. 2
gamma BHC	C. 1, 2	Niagara 5462	C. 8
BIO 5462	C. 8	OM-2174	R. 3
C-854	S. 1	OMPA	P/A. 14
C-1006	S. 1	OR-1191	P/A. 5
CL 38023	P/C. 12	OS-1897	F. 1
CP-14957	C. 9	R-1504	P/H. 7
CPCBS	S. 1	RE 4355	P/A. 6
DDT	D. 1	Bayer S-940	P/H. 8
DDVP	P/A. 3	S 1752	P/C. 10
DMDT	D. 2	Sumitomo S-1102A	P/C. 7
DMF	P/A. 13	SD 3562	P/A. 4
Dowco 132	P/C. 9	SD 4402	C. 9
Dowco 139	X. 3	SD 7859	P/C. 13
Bayer E-600	P/C. 3	SQ 8388	R. 3
Bayer E-601	P/C. 2	Velsicol 104	C. 4
Bayer E-605	P/C. 4	Velsicol 1068	C. 3
E-1059	P/A. 8		
E-3314	C. 4	Compounds identified	
EN 18133	P/H. 4	by number only	
ENT 24650	P/A. 12	666	C. 1, 2
ENT 24915	R. 1	1068	C. 3
ENT 24970	P/H. 6	1189	C. 7
ENT 25540	P/C. 10	4049	P/A. 10
ENT 25726	X. 4	7744	X. 2
ENT 25766	X. 3	17/147	P/H. 5
ENT 26316	R. 3	Compound 118	C. 5
ENT 50003	R. 2	Compound 497	C. 6
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